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VOL. 36. Ser. A. Part 2. pp. 33-72. FEBRUARY, 1948.

THE REVIEW OF APPLIED ENTOMOLOGY.

SERIES A: AGRICULTURAL.

ISSUED BY THE COMMONWEALTH INSTITUTE OF ENTOMOLOGY.

LONDON:
COMMONWEALTH INSTITUTE OF ENTOMOLOGY,
41, QUEEN'S GATE, S.W.7.

Price 4s. net.

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Report on the Use of DDT in the Control of Forest Insects.—*Bi-m. Progr. Rep. For. Insect Invest.* **2** no. 1, 8 pp., 4 figs. Ottawa, 1946.

Various authors report on the results of experiments with DDT for the control of forest insects in Canada and the United States during 1945.

N. R. Brown (pp. 1–3) describes an experiment in which about 100 sq. miles of forest in the Lake Nipigon region of Ontario were sprayed from the air against the spruce budworm [*Harmologa fumiferana*, Clem.]. The spray was applied at a rate estimated to give a deposit of 1 lb. DDT per acre from aeroplanes flying along lines marked at 200 ft. intervals at a height of 200–300 ft. above the tops of the trees and a speed of 125–150 miles per hour, so that it was distributed over a swathe about 200 ft. wide. Data collected during the operation by observers indicated that for part of the area covered, the minimum and maximum distances between the ground passed over in successive flights were 22 and 154 yds., but the actual coverage was more complete than would be expected from this since the spray was drifted by even slight breezes, and a wind of about 10 miles an hour carried it as far as 2,200 yds. from the point of release. There was no significant difference in the mortality of larvae feeding on balsam fir [*Abies balsamea*], white spruce [*Picea glauca*] or black spruce [*P. mariana*], or in trees of different classes. In an unsprayed area, mortality among larvae mining in the needles, in the buds and in old foliage and among the pupae was about 0·6, 6·7, 4·1 and 10·1 per cent., respectively. The corresponding percentage mortalities in a zone sprayed before many larvae had entered the needles and (in brackets) the effective control figures (estimated by Abbott's formula [*R.A.E.*, A **13** 331]) were 61·6 (61·3), 28 (22·8), 9 (5·1) and 7·4, respectively, there being no control of the pupae. The total percentage control was 71·6. No data are available for mortality among needle-mining larvae in two other zones that were sprayed when most of the larvae were in the needles and in the buds, respectively, but the corresponding figures for the other stages were 33·9 (29·2), 14·9 (11·3) and 6·5, and 9·5 (3·0), 12·4 (8·7) and 10·5, respectively. The average percentage loss of new foliage on co-dominant balsam fir was 70 in the first zone, 30 in the second, 63 in the third and 96 on unsprayed trees. Counts of pupae and of eggs of the succeeding generation made on a few balsam firs 6–7 ins. in diameter at breast height showed that the average numbers of pupae per tree were 1,283 on unsprayed trees and 1,740, 450 and 265 on trees in the first, second and third zones, respectively. The average numbers of eggs per tree varied from 12,813 to 19,775 in the three zones and was 29,341 in the unsprayed forest.

R. N. Johnston (pp. 3–4) reports on the technical problems involved in the mixing and application of the spray. Where the spray was mixed in the field, a steel drum with an electrically driven agitator was used, but the results were satisfactory only when the solvent (methylated naphthalene) was first heated. Combinations of two solvents and two diluents were used, and one that produced a fluid with a low vapour pressure was considered the most effective, since the amount of spray lost through evaporation was reduced. The insecticide was carried in one of the fuel tanks of the aircraft and distributed by means of two braced, paired and stream-lined tubes, each 8 ft. long with a single row of $\frac{1}{4}$-inch holes in the lower surface, fixed to the bottom of the hull, with the outer ends just inside the wash of the two engines. Delivery over the entire area slightly exceeded 1 gal. per acre, and distribution at flying speeds of 100–150 miles per hour was satisfactory. Standard navigational methods, utilising large-scale photographic mosaics of the area, were employed in making the flights; objections to this method are that it requires very detailed maps and a trained navigator. Balloons released from the ground or from another aeroplane were unsatisfactory in marking the course; crépe paper released from a marking aeroplane was effective in one test over round-topped, close-crowned deciduous trees. The trials showed that spraying a forest area of 100 sq. miles

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is economically practicable. DDT at 1 lb. in 1 gal. spray per acre reduced the numbers of larvae by about 50 per cent. and indications were obtained that the reduction would be still greater if 1 lb. DDT were applied in 2 gals. spray per acre. Some other insect pests were also controlled for a time, but there were no serious effects on other wild life.

Trials in the Kabonga area of Quebec, where defoliation by *H. fumiferana* had previously been light, but where heavy infestations were expected in 1945, are described by K. E. Stewart (pp. 4–5). The spray was applied from a Waco aeroplane equipped with pontoons and flying at 80–85 miles per hour, and released at the rate of 1 gal. per acre by means of a spinner-disk apparatus fed by gravity from a tank with a capacity of 50 gals. situated in the passenger compartment. The spray was prepared by dissolving 1 lb. DDT in 2 pints xylene and diluting it to the required concentrations with fuel oil; both concentrate and diluted spray can be stored for several days without recrystallising. The experimental plots were 660 ft. wide and 3,300 ft. long in the earlier tests, but in the later ones the length was 792 ft.; the spray was distributed in swathes 135–140 ft. wide when the aeroplane was flying at an altitude of 100 ft. in calm air. The plots were first marked by coloured wind-cones hoisted at the corners, but these were not readily discernible and were later replaced by hydrogen balloons raised at both ends of each flight line. The results were estimated from samples comprising a terminal twig with its laterals as far back as the third node. Severe frosts at the end of May damaged 70–90 per cent. of the developing buds and in many areas the older larvae fed on the foliage produced in 1943 and 1944. The criteria adopted in assessing the results were larval survival and the degree of defoliation; the two methods gave similar control figures. The first application was made on 16th May, when the larvae were mining the old needles. The larvae began to fall to the ground within a few hours and continued to do so for eight days, though most dropped during the first 24 hours. The DDT was applied at rates of ½ lb. in 1 or 2 gals. and 1 lb. in 1 gal. spray per acre and gave 45, 43 and 40 per cent. control, respectively. In further applications made on 25th May, when 44 per cent. of the larvae were feeding in the buds, DDT at rates of 1 lb. in 2 gals., 3 lb. in 3 gals., and 5 lb. in 5 gals. per acre gave 77, 96 and 99 per cent. control, respectively. On 13th and 14th June, when the larvae were half grown and feeding on the new foliage, DDT at rates of ½ lb. in 1 or 2 gals. spray gave 62 and 88 per cent. control, respectively, DDT at 1 lb. in 1 gal. gave 98 per cent. control, and DDT at 5 lb. in 5 gals. gave 99 per cent. Spray from the latter plot that drifted to a neighbouring one also gave 99 per cent. control; it represented only a small proportion of the total volume of spray delivered but a high percentage of the total number of small droplets. The sprays were not effective against the pupae. The number of eggs later deposited in plots sprayed while the larvae were present was reduced owing to control of the latter, but moths from other plots were not prevented from entering and ovipositing. Most of the insects exposed to the DDT were killed by it, but the effect did not last for more than 5 or 6 days and the insect fauna appeared normal after about ten days; no plant injury was recorded. The tests were carried out in the morning under optimum conditions, and in large-scale operations, where this would not be practicable owing to the time involved, the rate of application should be somewhat heavier; the rate is also influenced by the height and density of the stand.

L. Daviault (p. 5) calculates that the cost of spraying 1,000 acres of forest from the air with DDT at 1 lb. per gal. and a rate of application of 2 gals. per acre, worked out at about $3.21 per acre.

R. H. Nagel (pp. 5–6) discusses the results of the experiments against *H. fumiferana* in Quebec with reference to methods of reducing spray loss and describes others in Ontario. He suggests that the susceptibility of the older larvae to DDT noted at Kabonga is due to the large target that they present

to the larger spray particles and to the " space effect " of drifting particles. Larvae that survived the highest rate of application are thought to have been protected by webs or other shelter. Sprays applied on 4th July, when the adults were beginning to emerge in numbers, exerted no control. In Ontario, 12 plots of *Abies balsamea*, each about 15 acres in extent, were treated early in May, when the second-instar larvae were almost all feeding in the needles, though a few were in buds. The sprays were applied at rates of 0·5–5 lb. DDT in 1–5 gals. spray per acre from an aeroplane fitted with a spinner-disk distributor and flying about 50 ft. above the tops of the trees. The data were incomplete owing to cold weather between the applications, which reduced feeding, but evidence was obtained that the larvae abandoned many of the needle mines when the spray seeped through them and received a lethal dose from this seepage and from spray at the opening of the mines. Nearly all the larvae that fell to the ground following treatment were moribund, and a few died within the mines. Mortality at this period varied directly with the volume of spray applied per acre. The needles were wetted more easily when a large volume of spray was applied, but some larvae survived even the highest rate. The author concludes that the great variability in dosage-mortality observed in the trials in Quebec and Ontario was due largely to uneven spray deposits, and investigations in Maryland in the autumn of 1944 indicated that air movement, which was found to become more complex with increasing altitude, was important as a factor influencing the distribution of the spray. The flight factor could account for variations in deposits ; this can largely be overcome or reduced by the experience and training of the pilot and by developing an adequate system of marking the course.

Experiments in New Brunswick by L. J. Simpson to determine the value of DDT in preventing attack by borers in unbarked logs are described by R. E. Balch (pp. 6–7). Logs of conifers felled during the winter of 1944–45 and placed on skids fully exposed to sun and rain were treated on 11th June with dusts and sprays of DDT and barked in October. Logs treated with a 3 per cent. dust were moderately attacked. Two lots of logs sprayed with water suspensions of DDT (AK20 [*cf.* **35** 110] at 2½ and 5 per cent.) were free from attack except for two logs that contained 0·2 larvae per sq. ft. under the bark and in the wood, respectively. In two lots sprayed with 5 per cent. DDT in kerosene, only one log was attacked ; it contained 1·2 larvae per sq. ft. under the bark and 0·3 in the wood. Logs sprayed with 2½ per cent. DDT in kerosene were not attacked, and infestation in untreated logs was heavy. Secondary bark-beetles were plentiful in the controls, common in the dusted logs and absent from the sprayed ones. On the basis of these tests, it is considered that an emulsified solution of 5 per cent. DDT would prove the most effective ; it should be applied during the week preceding 15th June by means of a moderately course nozzle to all sides of the top layer of logs and to the top of the second layer. The front and back logs on the skids and the ends of all the logs should be sprayed as thoroughly as possible by inserting the nozzle between the logs.

Balch (p. 7) also states that experiments by C. C. Smith in New Brunswick showed that a suspension of ¼ lb. DDT (as AK20) in 100 gals. water, thoroughly applied to the leaves of shade trees, gives almost complete control of the larvae of the fall cankerworm [*Alsophila pometaria*, Harr.] in all four instars within 24 hours. This material was more effective than lead arsenate and somewhat cheaper. As spraying the whole tree involves expensive equipment and much labour and material, the effectiveness of spraying the lower part of the trunk only to destroy females crawling up it to oviposit was tested in the autumn. DDT was applied as water suspensions, oil solutions and emulsified solutions, and all killed considerable numbers of adults of both sexes that crawled over the deposits, but the effect of the suspensions did not persist for the required period (six weeks), apparently owing to heavy rains. Emulsified

solutions were the most effective and are less likely to injure the trees than oil solutions. Oviposition was prevented in some cases, but not in others. It is concluded that spraying the base of the trunk to a height of 8 ft. with an emulsified solution containing 5 per cent. DDT shortly before the adults begin to emerge gives good control under average weather conditions. Emergence occurs from about the middle of October until the end of November.

S. F. Potts (pp. 7–8) describes two blower-atomising units developed in Connecticut for the application from the ground of finely atomised and highly concentrated spray at low rates. The larger one had a six-bladed paddle-type fan driven by a 25 h.p. engine and completing 4,000 revolutions per minute, which delivered 1,500–1,600 cu. ft. of air per minute at 125 miles per hour. It drove the atomised spray to a height of 80–90 ft. in still air, and 75 ft. against a wind with a velocity of 5 m.p.h., and drifted it laterally for several hundred feet with the wind or in still air. The fan of the smaller unit turned at 3,000 revolutions per minute, was driven by a 12 h.p. engine, and delivered 1,500–1,600 cu. ft. of air per minute at 175 miles per hour. It drove the spray to the tops of trees 50 ft. high when the velocity of the wind did not exceed 5 m.p.h. Round discharge tubes gave greater air velocity and better coverage and drove the spray 70–120 per cent. higher than fish-tail ones. The volume of air, and not its velocity, appeared to be a primary factor in determining the effective height and distance to which the spray was driven. The rapid coverage with a minimum of labour and the fine atomisation given by these machines enable large areas to be treated quickly, effectively and cheaply. Owing to the low rate of application, the need for expensive high-pressure equipment and large amounts of water is avoided. Dusts and concentrated sprays can be applied separately or in combination, and the machines can also apply aerosols, though these are expensive. Blower-atomisers were successfully used on shade and orchard trees, forest, city property and crops in New England and New York against various insects including the gipsy moth [*Lymantria dispar*, L.], the elm leaf beetle [*Galerucella luteola*, Müll.], the Japanese beetle [*Popillia japonica*, Newm.], the pear Psylla [*Psylla pyricola*, Först.], tent caterpillars [*Malacosoma*], *A. pometaria*, flea-beetles, and leafhoppers. DDT or nicotine were generally used in the sprays, but tests with rotenone, pyrethrum, benzene hexachloride and lead arsenate were also included. The concentrate was applied at rates of ½–4 U.S. gals. per acre, with an average of about 1¼ U.S. gals. Individual trees required from 1 fl. oz. to 1 U.S. pint.

P. B. Dowden (p. 8) describes experiments in Connecticut on the control of *Lymantria dispar* by means of DDT sprays applied from the air and from the ground. The two types of aeroplanes used gave similar results, though the amount of insecticide released over an area and the amount deposited within it often varied considerably. DDT distributed at the rate of 1 lb. in 1·67 U.S. gals. fuel oil or kerosene per acre before hatching was complete gave almost complete control [*cf.* **34** 176], and the same amount of DDT in 1–1·67 U.S. gals. fuel oil per acre applied when hatching was complete generally gave complete control. DDT was frequently effective at ½ lb. per acre but gave only partial control at 2 oz. The optimum volume of spray per acre with the apparatus used appeared to be 1–1·67 U.S. gals. The oil sprays were about equally effective, and the addition of different auxiliary solvents to kerosene did not appear to affect the results. Oil sprays containing DDT were effective when applied to wet foliage or when heavy rain occurred soon after application. In the field, most mortality occurred within a few days of the application, but in cage tests, foliage from sprayed plots caused high mortality of healthy larvae even after long periods of weathering; mortality decreased as the dosage decreased and the period of exposure to weather increased. Sprays of oil alone were ineffective. Complete control was given by spraying with an emulsified solution of DDT, as the larvae were hatching, by means of power equipment from the ground, but the rate at which the spray was applied was

high. When the sprays were applied to larvae in the fourth and fifth instars, complete mortality was given by DDT at 1 lb. per acre but not at 8 oz. Survival was correlated with dosage, but the reduction in numbers was considerable even when only 2 oz. DDT was applied per acre. An oil solution of DDT and an emulsified solution applied, as the eggs were hatching, with hand pumps that produced a fine mist up to about 6 ft. from the ground reduced populations considerably, but did not give complete control.

Bolivar Pieltain (C.). **Existencia en España de un Coleóptero perjudicial no citado : *Thylodrias contractus* Motsch.** [The Presence in Spain of a harmful Beetle not previously recorded there.]—*Ciencia* **6** no. 7–9 pp. 298–299, 2 refs. Mexico, D.F., 1945.

Although the Dermestid, *Thylodrias contractus*, Motsch., was not recorded from Spain in a recent work on beetles associated with stored products [*R.A.E.*, A **33** 330], the author states that he has observed it frequently in houses in Madrid, where it caused no injury to silk, cotton or woollen fabrics [*cf.* **25** 553], but attacked entomological collections [*cf.* **20** 591]. Both the larvae and the adult females, which are apterous, were injurious.

Servadei (A.). **Sulla presenza in Albania della *Ceresa bubalus* F. e la sua diffusione in Europa.** [On the Presence of *C. bubalus* in Albania, and its Distribution in Europe.]—*Redia* **28** pp. 1–10, 3 figs., 70 refs. Florence, 1942.

The author reports the discovery of *Ceresa bubalus*, F., in a field of lucerne in which there were peach and apple trees, near Dibra, Albania, in 1941 [*cf.* *R.A.E.*, A **27** 474] and gives a brief account from the literature of the European distribution, bionomics and control of this Membracid, which injures fruit trees by its oviposition punctures.

Venturi (F.). **La *Lema melanopa* L. (Coleoptera, Chrysomelidae).**—*Redia* **28** pp. 11–88, 3 pls., 14 figs., 7 pp. refs. Florence, 1942.

The author describes all stages of *Lema melanopa*, L., summarises its geographical distribution, and gives an account of observations on its bionomics in central Italy in 1935–38, which he compares with those recorded in the literature [*cf.* *R.A.E.*, A **17** 502 ; **19** 658 ; **24** 678 ; **29** 463]. This Criocerid is a pest of cereals and grasses, particularly wheat, oats and barley. It had only one generation a year. The overwintered adults paired in spring and oviposited on the leaves of cereals ; oviposition began in late March or April and continued for 45–60 days according to weather. Females laid 100–150 eggs each, and up to four were found on a single leaf. The larvae hatched in 15 days or less in April and 7–8 days in May, and fed on the leaves, migrating from one to another. They became full-fed in 12–20 days and were present from late April to mid-June. Pupation occurred in cells in the soil at a depth of ½–2 inches. The adults emerged from the soil 20–25 days later and had all appeared by the end of June. They fed on wild grasses until autumn, when they hibernated among stones or in crevices and tufts of grass until mid-March.

The larvae were parasitised by an Ichneumonid of the genus *Thersilochus* and an unidentified Chalcidoid, the former being the commoner. It had only one generation a year. The adults emerged in late April or early May and paired immediately. The eggs were laid singly in third- or fourth-instar larvae of *L. melanopa* and hatched in about 11–14 days. The host entered the soil normally but died soon afterwards ; the full-fed Ichneumonid larva emerged from its remains after five days and spun a cocoon inside its cell, but did not pupate until the spring of the following year.

Control methods are reviewed from the literature but are unnecessary in central Italy, where infestation is not heavy and comes at a time when the crops are sufficiently advanced to resist attack.

CARIMINI (M.). **Esperienze di lotta contro gli insetti dei granai con tricloroacetonitrile (Tritox).** [Experiments on the Control of Grain Insects with Trichloracetonitrile (Tritox).] — *Redia* **28** pp. 103–137, 4 figs., 2 refs. Florence, 1942.

In further experiments in Italy on the control of pests of stored grain by fumigation [*cf. R.A.E.*, A **36** 30], trichloracetonitrile (Tritox) gave promising results in preliminary tests and was then applied at a rate of 2½ lb. per 1,000 cu. ft. in a warehouse containing two heaps of wheat infested by *Calandra granaria*, L., and *Sitotroga* [*cerealella*, Ol.]; the liquid was poured into basins arranged along the tops of the heaps, and containers holding grain infested by adults or larvae of *C. granaria* and larvae of *Ephestia* were inserted into them at various depths. After exposure for 72 hours at a temperature of about 24°C. [75·2°F.], complete kill of adults was obtained in containers to a depth of 16 inches, but a high proportion of the larvae, including those of *Sitotroga*, survived. Adults of *Sitotroga* and *Calandra* crawling over the grain or floor were also killed. In small-scale tests it was found that the fumigant did not evaporate well at temperatures below about 20°C. [68°F.]. It had no effect on germination at rates of up to about 3 lb. per 1,000 cu. ft. [*cf.* **33** 296]. Notes on the physical properties of trichloracetonitrile are given in a foreword by A. Melis.

ZINKERNAGEL (R.), GASSER (R.) & DOMENJOZ (R.). **Ueber Getreidekonservierung. 2. Mitteilung: Insektenbekämpfung mit insektiziden Stäubemitteln.** [Concerning Grain Preservation. Second Communication: Insect Control with insecticidal Dusts.] — *Mitt. schweiz. ent. Ges.* **19** pt. 12 pp. 653–691, 14 figs., 10 graphs, 31 refs. Berne, 1946.

This second part of a paper on the protection of stored grain [*cf. R.A.E.*, A **35** 383] contains a detailed account of large-scale experiments carried out in Switzerland in 1943–44 to assess the efficiency of a proprietary insecticidal dust (Geigy 33) containing 10 per cent. DDT for the control of insects infesting stored cereals. The literature on the treatment of grain with inert dusts is reviewed; since the DDT dust is used at a much lower dosage (1 : 1,000 by weight), it causes no appreciable increase in the bulk or weight of the grain. In the four experiments described, the DDT dust, at the above dosage, was added to the grain stream at different stages of its passage from one part of the silo to another; the best results were obtained when it was added at the earliest possible stage in this process, since mixing was more complete, and a special apparatus was devised for the purpose. In the first two experiments, the dust was applied to barley infested chiefly by *Calandra granaria*, L., *Rhizopertha dominica*, F., and *Latheticus oryzae*, Waterh. Samples taken periodically for a year showed that in both cases the numbers of living adults fell sharply during the first 7–10 days after treatment and then increased a little owing to the development of a new generation from eggs laid before treatment. In the first experiment, isolated adults of *Rhizopertha* were still present at the end of the observations, whereas no living adults of the other species were found 193 days after treatment or subsequently. In the second experiment, in which the barley was stored in five separate compartments of the silo, isolated examples of a second or later generation of *Rhizopertha* developed in most cases, although in one compartment no living beetles were found after 50 days; isolated examples of *Calandra* were also found several weeks after treatment, and there was a small second generation of *Latheticus* in one lot.

In the other two experiments, the dust was applied to infested wheat. It gave complete mortality of *Calandra* and *Oryzaephilus surinamensis*, L., in 78 days in the first case and of *Latheticus*, *Calandra* and *Rhizopertha* in 125 days in the second. Adults of *Calandra* are killed 6–8 days after contact with the dust, but the immature stages in the wheat are not affected.

These results were compared with those given by fumigation with methyl bromide. A quantity of fumigated wheat was observed for 65 days after treatment and it was found that infestation by *Calandra* increased immediately after fumigation ; there were no living adults 12–43 days after treatment, but examples of *Calandra* and *Latheticus* occurred subsequently. It is concluded that fumigation as commonly practised does not give complete mortality of adults, and much less of the eggs and larvae in the grain.

Since the DDT dust acts much more slowly than a fumigant, the authors consider that it would be most efficiently used to prevent infestation, which it would do for months or years. It can also be used to control insects in storage rooms and to prevent them from migrating from one lot of grain to another. Insects infesting sheds and other places where grain is stored can also be destroyed by spraying with an emulsifiable solution of DDT (Geigy 33 Liquid), diluted with 25–30 times its quantity of water.

In a section by R. Domenjoz on the possible danger to consumers of treating grain with DDT, it is shown that the residue left is only 9 parts DDT per million after the grain is cleaned and 4–6 parts after milling, which is well within the Swiss tolerance for hydrocyanic acid (10 p.p.m.). No ill effects were observed in laboratory animals that fed for 70 days on treated grain that had not undergone any of the normal cleansing processes or on bread baked from it.

In the final section, 17 species of insects that commonly infest stored grain in Switzerland are briefly described and figured, and notes are given on their habits and susceptibility to DDT.

WINTERINGHAM (F. P. W.) & HARRISON (A.). **The Sorption of Methyl Bromide by Wheat.** — *J. Soc. chem. Industr.* **65** pp. 140–149, 6 figs., 12 refs. London, 1946.

The following is the authors' summary. The total sorption and rates of sorption of methyl bromide by whole and milled wheat, by wheat glutenin and by wheat starch have been studied. An attempt has been made by mathematical treatment of the data to differentiate between the methyl bromide physically adsorbed and that chemically combined in wheat and in glutenin.

The effects of moisture and temperature on the sorption have also been studied. No evidence was found that hydrolysis accounts for the decomposition of methyl bromide in wheat ; methylation seems a more likely reaction. If the sorption of methyl bromide by the glutenin studied is typical of that of other protein constituents, it seems evident that the protein constituents are mainly responsible for the sorption by wheat. The sorption of methyl bromide by whole wheat has been investigated theoretically. The order of time required for the decomposition of residual physically held methyl bromide in fumigated whole wheat has been calculated.

LEWIS (S. E.) & ECCLESTON (K.). **Residues in Wheat Flour fumigated with Methyl Bromide.**—*J. Soc. chem. Industr.* **65** pp. 149–152, 6 figs., 10 refs. London, 1946.

The following is the authors' summary. Methods have been developed for the investigation of the nature of the residue in ground grain after treatment with methyl bromide. Evidence has been produced that the residual bromide

after two hours aeration is of a water soluble nature. The protein fraction of the grain has been shown to be the most active constituent in the reaction with methyl bromide, and some attempt has been made to determine the groups responsible.

MANOLACHE (F. C.). **Cercetări morfologice, biologice şi de combatere asupra insectei *Entomoscelis adonidis* Pall. in România.** [Investigations on the Morphology, Biology and Control of *E. adonidis* in Rumania.]—*Teze Fac. Ştiinţe Bucureşti* [2+] 205 pp., 5 pls. (1 col.), 132 figs., 1 fldg. table, 172 refs. Bucharest, 1940. (With a Summary in French.)

This thesis on *Entomoscelis adonidis*, Pall., an important pest of rape in Rumania, contains a review of the literature on this Chrysomelid and its distribution in various countries, detailed descriptions of all stages, an account of observations on its bionomics and control carried out in 1933–40 and a discussion of the damage caused and of factors favourable or otherwise to outbreaks. The beetle had only one generation a year and hibernated in the egg stage. The overwintered eggs hatched in February–March or sometimes later, and the larvae fed on the leaves of rape or other plants, chiefly crucifers, for 24–54 days in different years in the field and for 19 days in the laboratory at an average temperature of 20°C. [68°F.]. Mortality was high at constant temperatures of 25–29°C [77–84·2°F.] or 6–8°C. [42·8–46·4°F.]. When full-fed, the larvae entered the soil and passed the prepupal and pupal stages in earthen cells at a depth of 1–2 ins. The prepupal and pupal stages lasted 12–15 and 15–19 days in the field and the former lasted 5 days in the laboratory at about 20°C., while the duration of the latter ranged from 5 days at 29°C. [84·2°F.] to 57·5 days at 7·5°C. [45·5°F.]. The adults usually emerged in late April or early May in the Danubian plain, and one week later in the north. They migrated in search of suitable food-plants, covering distances of up to 6–7 miles, and fed on the leaves and flower buds of rape, and sometimes on the stems, causing them to break. The period of feeding ranged from 15 to 30 days in different years, and the beetles then entered the soil and aestivated for 3–3½ months in earthen cells at a depth of 6–11 ins. They resumed feeding in September and paired and began to oviposit a few days later.

The eggs were laid in batches in or on the soil. Females laid an average of 895 eggs in the laboratory at about 20°C., with a maximum of 2,143, the oviposition period lasting 5–42 days. In the field, normal oviposition occurred from late September to early November, and some individuals were observed laying eggs in December and January. The numbers of eggs laid were considerably less at constant high or low temperatures.

Both adults and larvae fed on numerous cultivated and wild plants, a list of which is given. Male and female adults taken in the field in September survived starvation for up to 39 and 44 days at a temperature just below 20°C., but for only 2 and 4 days at 27·5°C. [81·5°F.]. Larvae were most resistant in the fourth instar, in which 10 per cent. survived 15 days' starvation at about 20°C. Damage to rape was chiefly caused by larvae and newly emerged adults, the loss of crop amounting in some years to 40–100 per cent.

The climate of Rumania is favourable to the increase of the beetle, and even frosts in winter or spring do not kill the eggs or larvae. Clay soil or podsol is unfavourable. In view of its polyphagous habits, infestation cannot be reduced by suspending the cultivation of rape, even for several years. Natural enemies comprised the fungus, *Beauveria globulifera*, which attacked a small percentage of the aestivating adults, *Nabis ferus*, L., which preyed on the larvae, *Lebia cyanocephala*, L., which attacked the eggs, larvae and pupae, and the Tachinid, *Meigenia mutabilis*, Fall., which parasitised a very small percentage of the larvae. The larva of *L. cyanocephala* is described.

Of the cultural control methods tested, rotation of crops was ineffective, and the common practice of planting rape with maize was not of value in all localities. Some protection was afforded by planting trap strips of rape at the edges of fields before the main crop and destroying the beetles that congregated on them. Certain varieties of rape that reach maturity at the beginning of May escaped infestation. Some control was given by hand-collection of the beetles in May and again in autumn before they oviposited, and by burning the larvae in foci of infestation with the help of oil or straw. The practice of ploughing the rape under in infested fields in May usually kills up to 20 per cent. of the larvae, but would be more effective if carried out in March, when they are in the first or second instar and not resistant to hunger.

Of contact insecticides tested, sprays of tar distillates gave good control, but scorched the plants; a pyrethrum extract was effective, but too expensive, and a proprietary rotenone dust killed 80–92 per cent. of the larvae in 24 hours, but was difficult to apply. Of the stomach insecticides, proprietary sprays of calcium arsenate at 4–10 lb. per 100 gals. killed 80–90 per cent. of the larvae in 24–28 hours and 98–99 per cent. within 5–7 days. Calcium-arsenate dusts killed 99–100 per cent. of the larvae in 48 hours. A proprietary lead arsenate (3–4 lb. per 100 gals. water) was also effective, but a spray of 2–5 lb. Paris green and 2–5 lb. lime per 100 gals. water gave poor results.

MANOLACHE (C. I.), DOBREANU (E.) & MANOLACHE (F.). **Observaţii morfologice şi biologice asupra insectei** *Podagrica malvae* **Ill. (Coleoptera-Halticinae).** [Observations on the Morphology and Biology of *P. malvae*.]—*Bull. Soc. Nat. Român.* no. 17 pp. 27–66, 43 figs., 17 refs. Bucharest, 1943. (With a Summary in French.)

An account is given of observations on the bionomics of the Halticid, *Podagrica malvae*, Ill., carried out in the laboratory and the field near Bucharest in 1938–41. It attacks malvaceous plants and frequently occurs together with *P. fuscicornis*, L. [*cf. R.A.E.*, A **28** 498]. All its stages are described, and characters distinguishing the two species are given.

Two generations a year were obtained in the laboratory, where development from egg to adult lasted 42–52 days at 19–25°C. [66·2–77°F.] and 30 days at 29°C. [84·2°F.], but there was only one generation a year in the field, development being completed in 60–70 days. The adults hibernated under the dry leaves of *Althaea rosea*, or sometimes within the upper part of the stems. They resumed activity in March or April and fed on the leaves when the mean day temperature reached 8–11°C. [46·4–51·8°F.]. The plants attacked included *Althaea officinalis*, *A. rosea*, *Malva* spp., *Lavatera* and *Abutilon avicennae*, which has recently been cultivated experimentally in Rumania. Pairing began 7–10 days after the appearance of the adults, and oviposition a few days later, the eggs being laid over a period of 2–3 months in small batches in the soil round the roots of the food-plants. The number of eggs deposited by single females ranged up to 839 and was usually 300–400. Maximum oviposition occurred in April, May and June at 18–22°C. [64·4–71·6°F.], and the eggs hatched in 20–30 days. The larvae fed on the roots but did not interfere with the development of the plants, and the adults began to emerge at the end of June or early in July.

MANOLACHE (F. C.). *Nomophila noctuella* **Schiff. un nouveau parasite nuisible aux cultures de trèfle et de luzerne en Roumanie.**—*Bull. Sect. sci. Acad. roum.* **28** no. 1 pp. 55–82, 54 figs., 14 refs. Bucharest, 1945.

Clover and lucerne in Rumania are periodically attacked by the larvae of *Nomophila noctuella*, Schiff., all stages of which are described, and since a severe outbreak occurred in July 1940 in several districts, a preliminary study

of the bionomics of this Pyralid was carried out in field-cages and the laboratory. There appear to be three generations in the field, the moths appearing in May, at the end of July and in late August or early September, but six were obtained in the laboratory between 30th July 1940 and 26th May 1941. At temperatures of 16·8–21·7°C. [about 62–71°F.], oviposition began two days after emergence, and females laid up to 345 eggs each on the leaves, petioles or flowers. The oviposition period lasted 14–25 days, and the eggs hatched in 3–12 days at 16·3–27°C. [about 61–81°F.]. The larvae fed on the leaves and pupated in cocoons in the soil after 15–20 days at 21·2–23°C. [about 72°F.]. The pupal stage lasted 11–17 days at 18·2–21°C. [about 65–70°F.]. The lower threshold of development was calculated as 12°C. [53·6°F.].

The control measures recommended are mowing infested lucerne or clover, leaving transverse trap-strips at intervals of about 30 ft., on which the larvae congregate and can be destroyed by sprays, and harrowing in autumn or early spring.

Kovache (A.) & Ficheroulle (H.). **Sur l'utilisation des produits mouillants et des adhésifs comme adjuvants aux bouillies agricoles.**—*Ann. Épiphyt.* (N.S.) **11** fasc. 3–4 pp. 235–243, 1 ref. Paris, 1945.

Some adjuvants sold in France to improve agricultural sprays are described as wetting agents and others as adhesives, and the laboratory experiments described in this paper were carried out primarily to determine whether the latter actually possess the qualities claimed for them. It is pointed out that adhesion includes both initial retention and tenacity of deposit ; the first was measured by comparing the quantity of active material present in the deposit on leaves or a suitably prepared surface from a given quantity of spray with and without the adjuvant immediately after it had dried and the second by making the same comparison after the dried deposit had twice been sprayed with water for 15 minutes and dried. Wetting power was estimated as the ratio of the area covered to the volume of liquid used.

When commercial adjuvants were added to Bordeaux mixture at approximately the rates recommended by the manufacturers, they improved the wetting power of the spray and initial retention, but did not affect tenacity. Increasing the concentration to about four and ten times that recommended did not reduce wetting power or initial retention but considerably reduced tenacity (except in the case of sodium silicate) by increasing the solubility of the deposit. Tests with a number of miscible oils showed that most of these did not increase the wetting power of the spray and had little effect on initial retention of deposit on leaves but rendered the tenacity of deposits of Bordeaux mixture, already high, almost complete and in some cases improved the poor tenacity of calcium-arsenate deposits.

Boczkowska (M.). **Recherches sur les affinités existant entre le doryphore (*Leptinotarsa decemlineata* Say) et diverses variétés polonaises de pommes de terre. Première partie : Essais à Versailles.**—*Ann. Épiphyt.* (N.S.) **11** fasc. 3–4 pp. 191–221, 6 figs., 6 refs. Paris, 1945.

In view of the risk of the spread of *Leptinotarsa decemlineata*, Say, to Poland and the importance of the potato crop in that country, field and laboratory investigations were carried out at Versailles in 1939 to determine whether any of the varieties of potato already cultivated in Poland would be sufficiently resistant to attack to escape severe damage [*cf. R.A.E.*, A **25** 460]. Field observations showed that overwintered adults began to leave the soil on 22nd April and reached their maximum abundance on 19th May. Eggs were found from 13th May and hatched in about a week. Adults of the first generation began to emerge from the ground on 7th July, and some re-entered it to

hibernate from 21st July. Eggs were found from 19th July and small numbers of larvae were present for three weeks in August. Adults of the partial second generation emerged at the end of August and beginning of September.

The characters of the potato variety Hetman, which was readily attacked in the field, though not seriously injured, and which was used as a standard, are described, and the behaviour on it of adults of the overwintered and first generations, the duration of oviposition and the number of eggs laid, and the development of the larvae and pupae of the first generation are compared with those on nine other Polish varieties. The observations in the open indicated that the varieties can be divided into a group of five, including Hetman, that are infested by numerous overwintered adults, giving rise to large numbers of eggs and larvae, and another group of five that are practically exempt from serious attack. In cage experiments, the different varieties caused differences in the survival of the overwintered adults, the total numbers of eggs deposited and the average numbers of eggs per day per female. They also affected the proportion of sterile eggs and the survival of larvae, both on the plant and in the ground. In general the numbers of first-generation adults leaving the soil in the laboratory were less than the numbers of larvae that had entered, owing to mortality of adults after metamorphosis as well as of larvae and pupae, the proportion of adults to larvae varying with the different varieties. There was no significant difference in the duration of development on the different varieties, but the proportion of first-generation adults that entered hibernation and the numbers of pairs observed to mate differed according to the variety on which the insects had been reared. It is concluded that two of the varieties tested, Marszalek and Odyniec, would show considerable resistance to *L. decemlineata*.

From a consideration of the climatic conditions in Poland, it is considered that there would not normally be more than one generation of *L. decemlineata* in the year in the Province of Poznan, the developmental stages lasting 50–60 days, but that the rate of multiplication might be considerable.

Boczkowska [M.]. **Résistance de différentes variétés de pommes de terre vis-à-vis des attaques printanières du doryphore.**—*Bull. Soc. ent. Fr.* **51** no. 3 pp. 42–44, 1 fig., 1 ref. Paris, 1946.

The results are given of observations on potato plants of ten Polish and two French varieties that were each caged with 16 examples of *Leptinotarsa decemlineata*, Say, towards the end of May 1940, when they were about 1–2 inches high. Some varieties were destroyed in a few days, whereas others survived with varying degrees of success, in some cases because the shoots were not favoured by the insects and in others because, although heavily attacked, they grew so rapidly and produced so many new shoots that they soon recovered. The variety Marszalek [*cf.* preceding abstract] was an example of the former type of survival. Degenerate and late plants succumbed to attack more quickly than others.

Martelli (G. M.). **Principali parassiti animali delle piante agrarie e dei prodotti alimentari nella Libia Occidentale.** [The principal Animal Parasites of Crops and Food Products in Western Libya.]—*Agricoltura colon.* **35** no. 10 pp. 383–390, 3 refs. Florence, 1941.

From observations made over a period of five years, the author gives lists of plants of economic importance in Tripolitania showing the insects and other pests that attack them [*cf. R.A.E.*, A **26** 260; **28** 295]. Pests of stored products are recorded in a brief final section.

Risbec (J.). **Les insectes de l'arachide.**—*Trav. Lab. Ent. Sect. soudan. Rech. agron.*, 21 pp., 1 pl. [Rufisque] Off. Insp. Condit. Prod. nat. Sénégal [1941].

This is a review of the insects associated with stored ground-nuts in Senegal [*cf. R.A.E.*, A **5** 339] and includes notes on the appearance and bionomics of most of them together with a discussion of control measures. The only insects that bore through the uninjured pods to feed on the kernels inside are larvae of the Bruchid, *Pachymerus cassiae*, Gylh., but kernels in damaged pods are infested by *Corcyra cephalonica*, Staint., which is fairly injurious, *Ephestia cautella*, Wlk., which is less harmful, *Tribolium confusum*, Duv., *T. castaneum*, Hbst., *Oryzaephilus surinamensis* var. *mercator*, Fauv., and *Homala polita*, Sol., which is rare. *Thermobia domestica*, Pack. [*loc. cit.*] is apparently of little importance. Harvested ground-nuts that are being dried for storage are attacked by several of the Coleoptera, and also by the Lygaeids, *Aphanus sordidus*, F. [*cf.* **35** 216], *A. apicalis*, Dall., and *Dieuches patruelis*, Stål, which pierce the pods and suck the kernels, reducing the oil content. Shelled ground-nuts are damaged by *Lasioderma serricorne*, F., *Tribolium* spp., and *Embia vayssierei*, Navàs [*cf.* **22** 593]. *Tenebroides* (*Trogosita*) *mauritanicus*, L., preys on the larvae of other insects, but in their absence can develop on ground-nut kernels. The beneficial insects comprise *Bracon* (*Habrobracon*) *hebetor*, Say, which parasitises the larvae of *Corcyra* and *Ephestia*, *Rhabdepyris* sp., which parasitises those of *Tribolium* spp., *Euchalcidia* sp., which parasitises *Pachymerus*, *Cephalonomia* sp., which parasitises the eggs of the Lygaeids, and *Coranus pallidus*, Reut., which is predacious on the nymphs and adults.

Much of the damage caused by storage pests would be avoided by postponing the shelling of the ground-nuts and exporting the crop as soon as possible. Ground-nuts from a new crop should never be stored with those from a previous one or in premises that have not been disinfested. Spraying with an emulsion of oil and soap is recommended for this purpose. Since infestation affects only the surface of the heaps, these should be arranged so as to present the least possible surface area. Bags should be stacked in the same way and disinfested before use, especially if they originate from premises harbouring *Lasioderma*. Air-tight storage and disinfestation of stocks by heat or a suitable fumigant are desirable but impracticable at present in Senegal. Little is to be hoped from the introduction of new parasites, but the existing species should be introduced into any stores in which they do not already occur. Measures for protecting drying ground-nuts from the Lygaeids [*cf.* **35** 216] include exposing them on concrete floors and applying an insecticide or repellent to damp sand in the vicinity, in which the bugs oviposit.

Smee (C.). **Report of Entomologist, 1945.**—5 pp. typescript. [Zomba, Dep. Agric.] Nyasaland [1946].

No crops in the Nyasaland Protectorate were seriously attacked by insects during 1945, but a rather large area of cassava was completely defoliated by *Zonocerus elegans*, Thnb., late in 1944, and *Citrus* grown from seed was fairly heavily infested by *Pseudaonidia trilobitiformis*, Green, in February 1945, though budded stocks were comparatively free. Tung [*Aleurites*] in a nursery near Zomba was seriously damaged in December 1944 by larvae of *Orgyia mixta*, Sn., which were exceptionally abundant on "bush" trees throughout the district, and various Coccids continued to occur sporadically on tung trees of all ages [*cf. R.A.E.*, A **34** 63]. A species of *Bucculatrix*, possibly *B. ruficoma*, Meyr., on sweet potato, was rather heavily parasitised by *Apanteles diparopsidis*, Lyle. From late November 1945 until February 1946, some fairly large loose swarms of the Tettigoniid, *Homorocoryphus vicinus*, Wlk., were

reported from the Southern, Central and Northern Provinces; they caused some local damage to cereals in the Southern Province.

In 1945, an outbreak of *Laphygma exempta*, Wlk., occurred in the Southern Province for the fourth year in succession [*cf. loc. cit.*]. It continued from March to May, larvae being recorded from Mlanje, Mikalongwe, Cholo, Blantyre and Zomba, but they were confined to grasses and did not affect any cereal crop. In Zomba, disease and parasitism by *Euplectrus laphygmae*, Ferrière, appeared early, and parasitism by *Apanteles maculitarsus*, Cam., was heavy from the middle of April. *E. laphygmae* had appeared in nearly every outbreak year, usually early in the outbreak, and species of *Apanteles* usually became prevalent later, and were themselves attacked by hyperparasites towards the end of the outbreak. In 1944, a species thought to be *A. transvaalensis*, Cam., was very prevalent by April, but 35 per cent. of a sample of 63 cocoons were parasitised by *Eurytoma syleptae*, Ferrière, 20·63 per cent. by *Pleurotropis nigripes*, Wtstn., and 6·26 per cent. by other Chalcidoids, while a further 27 per cent. produced no adult insects. In 1945, four of 15 cocoons of *A. maculitarsus* were parasitised by Chalcidoids. In 1946, small outbreaks of the armyworm occurred in Zomba in March and April. Cocoons of the species of *Apanteles* thought to be *A. transvaalensis* were abundant by the end of March, but only one of *A. maculitarsus* (parasitised by a Chalcidoid) and four of *A. ruficrus*, Hal., were found; of 145 cocoons of *A. transvaalensis*, 7·6 per cent. were parasitised by *P. nigripes*, 4·14 per cent. by *E. syleptae*, 13·8 per cent. by other Chalcidoids, 3·43 per cent. by two species of Ichneumonids, and 3·43 per cent. by *Ceraphron* (*Calliceras*) sp.; 13·8 per cent. of the cocoons gave rise to no adult insects.

VAN DER PLANK (J. E.) & ANDERSSEN (E. E.). **Kromnek Disease of Tobacco; a mathematical Solution to a Problem of Disease.**—*Sci. Bull. Dep. Agric. For. S. Afr.* no. 240, 6 pp., 9 refs. Pretoria, 1945.

The following is substantially the authors' summary of this account of a method of overcoming losses of Virginia tobacco due to spotted wilt (kromnek disease) in South Africa, where the causal virus [*Lethum australiense* var. *typicum* of Holmes] is usually transmitted by *Frankliniella schultzei*, Trybom, and sometimes by *Thrips tabaci*, Lind. [*cf. R.A.E.*, A **28** 638–640]. As these thrips do not normally breed on tobacco leaves, there is ordinarily no multiplication of vectors within fields of Virginia tobacco, which for cultural reasons is prevented from flowering. On the assumption that infection in a field is built up by vectors invading from without, settling at random and remaining without spreading the disease from plant to plant, it is calculated that increasing the number of plants per acre n times reduces the proportion of plants infected from $1-q$ to $1-\sqrt[n]{q}$, where q is the proportion of plants that are healthy at the standard density of planting. A fairly wide range of experiments with different varieties verified this calculation within reasonable limits of accuracy.

The density of planting can be increased by setting out several plants per hill without altering the spacing between hills, so that there is no gap in a row unless all plants in a hill become infected. With n plants per hill, the proportion of hills totally infected is $(1-\sqrt[n]{q})^n$, where q has the same meaning as before. A table is given for $n=2$ and $n=3$, which shows that planting in pairs suffices to overcome an outbreak that would have destroyed 40 per cent. of a crop set out in the usual way with one plant per hill. Planting in threes suffices for all but abnormally severe outbreaks. The method of denser planting is particularly useful during the first month or two after transplanting, when there is little danger of overcrowding and stands do not need thinning. It is during this period that there is the greatest danger of infection by spotted wilt in the Transvaal.

EASTWOOD (H. W.). **Bunchy Top Disease of Bananas controlled by co-operative Effort.**—*Agric. Gaz. N.S.W.* **57** pts. 11–12 pp. 571–577, 643–646 ; **58** pt. 1 pp. 26–30, 11 figs., 1 ref. Sydney, 1946–47.

This is an account of the campaign against the bunchy-top disease of banana in New South Wales and its results. The disease was first reported in Australia in 1913, having been introduced in suckers from Fiji, and by 1927 had almost destroyed the rapidly expanding banana-growing industry in New South Wales and Queensland. Following the discovery that it was caused by a virus and that an Aphid [*Pentalonia nigronervosa*, Coq.] is the specific vector [*R.A.E.*, A **16** 66, etc. ; **29** 149], regulations were passed in New South Wales in 1927 [**16** 124] setting up a quarantine and enforcing the destruction by growers of all infected stools under a system of official inspection. Replanting with disease-free suckers was permitted in 1928, but the subsequent growth of the industry was so rapid that a collapse set in, with the result that the regulations were neglected and the disease began to spread again in 1935. A scheme was then drawn up and financed by the Banana Growers' Federation whereby all plantations in affected districts were inspected regularly and all infected stools treated against the Aphid and destroyed by trained workers. The disease has been satisfactorily controlled in all areas as a result.

An attempt to eradicate the disease altogether was begun in 1937 in the isolated Yarrahappini district, the measures adopted including field sanitation, the spraying of diseased stools with power kerosene, digging them up completely, cutting them into small pieces and spraying them again on the ground [*cf.* **21** 570] and spraying adjacent stools with nicotine sulphate [*cf.* **18** 31]. Good progress was made at first, but the disease has occurred in five plantations since 1938 and was present in at least one in 1946. It was found in the course of the work that the virus lies dormant in the plants for indefinite periods, so that the only method of eliminating the disease altogether in a few years appears to be the complete destruction of all plantations in which it has occurred. It has not spread from infected to healthy plantations, however, since the beginning of the campaign. The savings so far effected are discussed.

Insect Pests.—*Agric. Gaz. N.S.W.* **58** pt. 2 pp. 81–84, 6 figs. Sydney, 1947.

This part of a series on insect pests in New South Wales [*cf. R.A.E.*, A **35** 371] contains notes on the bionomics of *Gnorimoschema operculella*, Zell., on potato, and on measures for its control in the field [*cf.* **35** 276, 316, etc.] and on potatoes stored for eating [*cf.* **25** 634 ; **31** 184]. Seed potatoes can be completely protected by treatment with a 2 per cent. DDT dust at about ¾ lb. per bag, but DDT should not be used on table potatoes, as the residue may render them harmful or distasteful.

HELY (P. C.). **Control of French Bean Fly. Experiments with DDT.**—*Agric. Gaz. N.S.W.* **58** pt. 2 pp. 85–89, 3 refs. Sydney, 1947.

In view of the high cost of sprays of nicotine sulphate and white oil recommended for the control of *Agromyza phaseoli*, Coq., on beans in New South Wales [*cf. R.A.E.*, A **28** 564] and their tendency to scorch the leaves and reduce the yield, experiments were carried out in February–April 1946 to compare them with DDT sprays, which gave promising results in preliminary trials [*cf.* **34** 384]. The sprays tested included nicotine sulphate (1 : 640) alone or with 6 fl. oz. white-oil emulsion (80 per cent. oil) or 1 lb. raw sugar per 4 gals. ; 0·05 per cent. DDT prepared by diluting a concentrate consisting of 10 per cent. DDT in solvent naphtha with a cresylic-acid type emulsifier ; and 0·05 or 0·1 per cent. DDT prepared by diluting an emulsion of the mayonnaise type containing 20 per cent. DDT. In addition, the effect of adding 1 per cent. lime-sulphur (20 per cent. polysulphide sulphur) to the 0·1 per cent. DDT spray

or using a dust of 40 per cent. sulphur, 59 per cent. pyrophyllite and 1 per cent. DDT was also tested, as the application of DDT sprays to beans in 1945 had been quickly followed by an increase in infestation by red spiders [*Tetranychus*]. The spray containing sugar was tested because insectary and field observations had indicated that bait-sprays of nicotine and sugar were toxic to the adults.

The treatments were applied seven times between 15th February and 6th March, concluding one week before blossoming, to beans sown on 5th February. From 25 to 30 gals. spray per acre were used in the earlier applications, and about 50 gals. in the final sprays ; the dust was applied at an average rate of 9½ lb. per acre per application. Treatments were applied to the upper leaf-surfaces only, and in all instances it was observed that less material was used with the DDT sprays than with the nicotine sprays, owing probably to the excellent wetting qualities of the former. Adults of *A. phaseoli* were numerous throughout the experiment, and self-sown plants outside the cultivated area were so heavily infested that they died before reaching a height of more than 6 ins. The beans were picked at intervals from 27th March to 17th April. There was a slight but general tendency for the plants sprayed with DDT to mature somewhat later than those sprayed with nicotine, but this was attributed to their rather better condition, and as picking proceeded it became evident that they yielded beans of a better quality. The yields per plot were 519 lb. per 0·05 per cent. DDT as the mayonnaise emulsion, 494 and 469 lb. for 0·1 per cent. DDT with and without lime-sulphur, 439 lb. for DDT in solvent naphtha, 466 lb. for nicotine sulphate and white oil, 407 lb. for the bait-spray, 389 lb. for nicotine sulphate alone, and 306 lb. for the DDT dust, a difference of 72 lb. being significant. It was subsequently learned that the DDT used in solvent naphtha contained only 65 per cent. p,p′ isomer, which may account for the less satisfactory results given by it. Many of the beans on the dusted plants were of poor quality, and it is thought that these plants were as severely infested as if they had received no treatment.

Counts of adults of *A. phaseoli* on some of the plants made about two hours after the first and second spray applications showed that only nicotine sulphate and white oil had any appreciable repellent effect. The plants sprayed with nicotine sulphate and sugar were visited readily by the flies, although insectary tests had indicated that this mixture was repellent if alternative food was available. There was no evidence that it attracted the flies to the plants, but they appeared to feed on it, became sluggish after a time and fell to the ground. Some flies became sluggish after a period of contact with plants sprayed with DDT, and although oviposition seemed to be normal, the hatching and development of larvae in sprayed foliage appeared to be diminished. Stem infestation was negligible on all the DDT plots except that treated with the solvent naphtha spray, light for nicotine sulphate and white oil and fairly heavy for the other treatments.

There was no noticeable increase in infestation by *Tetranychus* on any of the plots ; slight infestation by Jassids occurred on all the plots sprayed with nicotine sulphate, but they appeared to be well controlled on all the plots sprayed with DDT.

CALDWELL (N. E. H.). **Recent Locust Outbreaks in South Queensland.**—*Qd agric. J.* **64** pt. 3 pp. 164–167. Brisbane, 1947.

Chortoicetes terminifera, Wlk., was of little importance in southern Queensland for several years after the outbreak of 1937–38 [*R.A.E.*, A **27** 602], though a localised outbreak occurred in one district in the spring of 1945. In the spring of 1946, hopper bands were reported at several places, notably the Bowenville-Jondaryan area, where valuable agricultural crops were threatened, and the Goondiwindi area, which is a notorious danger spot for outbreaks of this locust. In the Bowenville-Jondaryan area, nymphs in the fourth and fifth

instars were reported during the first week in November ; they had evidently hatched early in October from eggs laid chiefly in hard clay ridges along the banks of a creek by females in flying swarms present in the preceding April. They completed their development in the second half of November, and most of the adults migrated to the south-east ; eggs were laid in late November and December over an area about ten miles by five and gave rise to the main hopper bands of the next generation. Some of the adults migrated to the south, but the hoppers to which they gave rise were of no economic importance. Second-generation hoppers were reported at the end of December and had evidently begun to hatch in the middle of the month. As a result of the severe drought, little grass was available for food, and since crops of sorghum and *Panicum* were threatened, a control campaign was carried out by the local farmers. Supplies of the standard poison bran bait were inadequate, and sprays of engine sump oil, generally diluted in kerosene, or of tractor fuel oil were used. The oil was applied by means of hand-operated pumps or, with better results, by power-equipment mounted on a truck from which three men operated independent hoses as it was driven through the bands of hoppers. The danger to the crops was in general averted, but the results were hampered by the late start, the scattered distribution of the eggs in small beds, which the hoppers left soon after hatching, the rapidity with which the hoppers moved, the frequency with which they changed their direction, and the difficulty of spraying bands that had invaded well-grown crops, although in some cases control was successful under these circumstances. The cost of the campaign, which was relatively high owing to the high price of the materials, is discussed.

In the Goondiwindi area, hopper bands were present in the spring of 1946, and dense swarms of flying adults were observed in the third week of November. This area adjoins a similar one in New South Wales, and some interstate migration of flying swarms took place. Second-generation hoppers were first reported in December, and subsequently occurred in large bands over an area 70 miles long and 30 miles wide, causing considerable damage to grass and a few cereal crops, though not to tobacco. Flying adults were again noted towards the end of January, when hoppers in various stages were still present. No organised control measures were adopted, since the value of the grass involved did not justify the expense.

Outbreaks were reported in three other areas, in one of which some damage to cereal crops ensued ; the others evidently did not become serious, owing no doubt partly to scarcity of food as a result of the drought.

WATERSTON (J. M.). **Report of the Plant Pathologist (Bermuda) for the Year 1945.**—12 pp. Hamilton, Dep. Agric., 1946.

Entomological investigations in Bermuda in 1945 again dealt mainly with pests of the Bermuda cedar (*Juniperus bermudiana*) [*cf. R.A.E.*, A **34** 190, etc.], and two Coccids not hitherto known on the island, *Lepidosaphes newsteadi*, Šulc, [*cf.* **34** 190] and *Diaspis visci*, Schr., were observed attacking it. *L. newsteadi* was first collected on 4th December 1944, and was later found at several localities. It had probably been introduced into one of them on coniferous nursery stock and the trees in that district are overgrown with *Jasminum gracile*, which may have acted as a screen and enabled it to become established without detection. Infestation varied in intensity, and as it remained fairly constant throughout the year on trees on which it was light, whereas more severely infested trees died out, it is thought that resistant strains of the tree may exist. *D. visci* was first collected on 27th August 1945, and is thought to have been introduced on coniferous nursery stock received from California in December 1942. It occurred over a smaller area than *L. newsteadi*, but the foliage of all the trees within an infested area of about three acres appeared

brown, some trees were severely defoliated, and others had died. It was parasitised by *Aspidiotiphagus citrinus*, Craw, which was already known in Bermuda as a parasite of *Chrysomphalus agavis*, Tns. & Ckll., on *J. bermudiana* [*loc. cit.*] and *Comstockiella sabalis*, Comst., on *Sabal bermudiana*, while *Aphytis mytilaspidis*, LeB., which has been recorded from it [in Belgium (**22** 52)] attacks *C. sabalis* in Bermuda. A mite that causes severe browning and defoliation of *J. bermudiana*, especially in hot, dry weather during early spring and summer, has been identified as *Paratetranychus ununguis*, Jac. The damage is reduced by thinning and pruning the trees, and the mite was controlled in one locality by spraying with 2 per cent. oil emulsion during the winter.

The hot, dry summer caused an increase of *Gnorimoschema operculella*, Zell., which injured stored potatoes following a failure in the refrigeration plant. Between 19th March and 14th April, parasite material estimated to yield 86,000 adults of *Bracon* (*Microbracon*) *gelechiae*, Ashm., and 45,225 adults of *Chelonus phthorimaeae*, Gah., was received by air from California. Larvae of *Gnorimoschema* were first observed in the field on 22nd March, and were mining the leaves in most fields and the tubers in one by the middle of April ; they were less common in tomato foliage. The parasites were received in eighty wooden boxes, each fitted with a cork, and this was replaced by a glass phial soon after arrival. When 10–20 adults were seen in the phial, the box was placed in an infested field and left uncorked. A few were placed in tomato fields in which the presence of *Psara periusalis*, Wlk., indicated that adequate spraying had not been performed, and in which, as a consequence, *Gnorimoschema* was possibly more abundant.

Other insects recorded during the year were *Diaprepes esuriens*, Gylh., which attacked the leaves of *Citrus* during October and November, and *Diabrotica duodecimpunctata*, F., living examples of which were intercepted on crates of lettuce imported from Oregon.

Silveira Guido (A.) & Conde Jahn (E.). **El pulgón verde de los cereales en el Uruguay** (*Toxoptera* [=*Schizaphis*] *graminum* **Rondani**). [The Green Aphid of Cereals in Uruguay.]—*Rev. Fac. Agron. Univ. Montevideo* 1945 no. 41 repr. 54 pp.+1 p. errata, 12 figs., 3 maps, 13 tables (11 fldg.). Montevideo, 1946.

Toxoptera graminum, Rond., was first found in Uruguay in 1937, but remained of little importance until 1944, when a serious outbreak occurred in all parts of the country. Losses of oats and artificial grasses ranged from 15 to 100 per cent. of the cultivated area in the different Departments, with an average of about 70 per cent. Descriptions of the various stages of the Aphid are quoted, its distribution is shown on maps and lists are given of its food-plants throughout the world and in Uruguay, where it attacks oats, wheat, barley, rye and pasture grasses. The damage has usually been patchy, occurring in hollows and sheltered places, but in 1944 many entire crops were affected and some oat plants in the Departments of Colonia and Montevideo carried populations of 1,000 Aphids, the average number in that year being 200, as compared with a maximum of 40 observed in 1937.

In laboratory tests on young plants in pots and boxes, oats, barley, wheat and rye were susceptible to attack in that order, with some differences in susceptibility among varieties of wheat and rye [*cf. R.A.E.*, A **34** 375]. Studies of the life-cycle of *T. graminum* [*cf.* **33** 310] were begun in June 1944 with apterous females taken in the field and transferred individually to oat plants in pots in the laboratory, in an open-air shelter or in an incubator, and the results are shown in detail in tables. The young Aphids moulted four times before reproduction, almost without exception. Individuals that developed in the laboratory and the outdoor shelter in August began to reproduce in an average of 16·2 days and those that did so in January in 7·2 days. The average

duration of the reproduction period in the laboratory ranged from 40 days for individuals that developed in September–October to 12·5 days for those that did so in December, and was a few days longer for those reared in the outdoor shelter. Adults survived on the average for 30–40 days and produced 11–153 offspring.

Chemical control is considered too costly for general use, but in tests in 1937 a spray of 0·2 per cent. nicotine sulphate and 0·4 per cent. soft soap gave the best results. When small areas are attacked they may be destroyed by fire, and the use of fertilisers is recommended to give greater resistance to the plants. *T. graminum* was parasitised in Uruguay by the Braconids, *Aphidius platensis*, Brèth., and *Diaeretus plesiorapae*, Blanch., and also to a small extent by *Aphelinus mali*, Hald., which was introduced in 1921 for the control of *Eriosoma lanigerum*, Hsm., on apple. It also had several hyperparasites, those identified being *Pachyneuron siphonophorae*, Ashm., *Asaphes* sp., *Aphidencyrtus* sp., *Horismenus* sp., *Charips grioti*, de Santis [**26** 290], another species of the same genus, probably *C. brassicae*, Ashm., and *Alloxysta* sp. These were active chiefly in May and June. Of a batch of 108 parasites and hyperparasites of *T. graminum* collected in the field in May 1944, 72·22 per cent. were *Aphidius platensis*, 20·37 per cent. *Diaeretus plesiorapae* and 6·48 per cent. hyperparasites.

A. platensis, of which the original description is quoted, has been reported only from Uruguay and Argentina, though it probably also occurs in Brazil. Its life-history is briefly described [*cf.* **26** 290 ; **33** 311], and it is recorded that of 210 adults examined, 120 were females. The percentage parasitism was 50 at one place, and the parasite was observed developing in both alates and apterae. It was also found attacking *Macrosiphum solanifolii*, Ashm., *Myzus persicae*, Sulz., *Aphis gossypii*, Glov., *A.* (*Rhopalosiphum*) *maidis*, Fitch, and other Aphids in the field [*cf.* **26** 290], but was not taken in December–February, in which months *T. graminum* could also not be found. The control of *Toxoptera* might be improved by releasing large numbers of *Aphidius* in spring as soon as the Aphid appears in the fields, and these might be obtained by breeding in the laboratory in winter and early spring or by collecting in October. When pupae collected in Argentina or reared in the laboratory in that month were kept in cold storage at 5°C. [41°F.], about 1 per cent. gave rise to adults in the first few weeks, but none of the others did so, even though transferred to laboratory temperature after two months. The parasite is best conveyed in the pupal stages, but a high precentage of adults survived after six days when transported in lamp-glasses and given food and water.

Diaeretus plesiorapae was observed in the field in every month except April, and was also reared from *Brevicoryne brassicae*, L., of which it is an important parasite [*cf.* **32** 99], *Myzus persicae*, and *Macrosiphum solanifolii*.

Some examples of *T. graminum* were found to be attacked by *Entomophthora* (*Empusa*) *aphidis* [**34** 300], but it was not thought possible to cultivate this fungus without further investigations. Predators included Syrphids, Chrysopids and several species of Coccinellids.

DAGUERRE (J. B.). **Hormigas del género *Atta* Fabricius de la Argentina (Hymenop. Formicidae.).** [Ants of the Genus *Atta* in Argentina.]—*Rev. Soc. ent. argent.* **12** no. 5 pp. 438–460, 4 pls., 3 figs., 1 map, 16 refs. Buenos Aires, 1945.

The leaf-cutting ants of the genus *Atta* that occur in Argentina, all three of which belong to the subgenus *Neoatta*, are *A. sexdens piriventris*, Santschi, *A. vollenweideri*, Forel, and *A. laevigata saltensis*, Forel. A key to them based on the workers is given, together with accounts of their distribution and descriptions of the ways in which their nests are constructed, to facilitate their identification from the appearance of the mounds. All occur in the north-east

of the country; *A. s. piriventris* is associated with aluminoferrous soil, *A. vollenweideri*, which is restricted to Argentina, chiefly with clay soil, and *A. l. saltensis* with sandy soil. In districts in which the soil is suitable to both, the last two species build nests close to each other. All were destructive to vegetation: *A. vollenweideri* showed a preference for the young leaves of graminaceous plants, which were transported to the nest by paths on the surface; the other two reached their supply grounds by means of underground galleries, some of which were nearly 200 ft. in length.

Report of the Federal Experiment Station in Puerto Rico, 1945.—62 pp., 33 refs. Washington, D.C., 1946.

This report contains a number of papers dealing with work in Porto Rico on plants that are or may be sources of insecticides and on insect pests.

In **Chemical Investigations** (pp. 17–20), M. A. Jones & C. Pagán give the results of further experiments on the effect of storage under various conditions on the retention of rotenone and other extractives in undried derris root [*cf. R.A.E.*, A **34** 217], from which they conclude that the presence of mould or a punklike appearance in the stored root is not necessarily accompanied by loss of rotenone and other toxic constituents, the main factors resulting in deterioration being apparently root formation and oxidation. Since both these factors are effective only in living root, deterioration can best be prevented by rapid drying. Pieces of derris root that were dried in the sun or the shade, either whole or split, showed no loss of dry matter or extractives, as compared with those dried in a vacuum oven over calcium chloride. Comparison of the quantities of rotenone and rotenoids in individual pieces of root did not reveal any consistent relationship with the diameter or position of growth. A rather gnarled root showed a low value, and in general the fine roots about 1 mm. in diameter were inferior. Neither shallow nor deep roots were consistently rich or poor in quality, no diameter was found to be optimum, and the degree of branching did not appear to affect quality.

In **Chemical Examination of Mamey Seed** (pp. 20–22), M. A. Jones & H. K. Plank describe further tests on the toxic principle in mamey seed (*Mammea americana*) [*cf.* **33** 338–339]. The various fractions and derivatives of the original material were evaluated at the concentration at which they occurred in it by homogenising an alcoholic solution of the fraction with inert marc obtained by 12 hours' extraction of the original powder with acetone, and testing the resultant powder against susceptible insects in the laboratory. The separation of different toxic and non-toxic fractions is described. Of several solvents tested, acetone, ethyl ether, benzene and carbon bisulphide readily extracted all the toxic principle, but petroleum ether, although slow in action, was the best solvent for the preparation of an extract for chemical examination because it removed least non-toxic material. Certain chemical tests suggested that mamey seed might contain pyrethrins, but biological tests with larvae of *Diaphania hyalinata*, L., and adults of *Diabrotica bivittata*, F., indicated that its toxicity was not due to pyrethrins, but to another perhaps somewhat similar ester.

In **Plant toxicological Studies** (pp. 22–25) by H. K. Plank, the results are given of investigations on the insecticidal properties of parts of various plants. In the tests on Lepidoptera, larvae were used. The materials included the seeds of six introductions of two varieties of *Pachyrhizus erosus* and one variety of *P. palmatilobus*. On account of the high oil content of the seeds, an equal part of the corresponding pods, which with one exception were inert to all the insects tested, was added to facilitate grinding. Dusts of two introductions of the first variety of *P. erosus* from Mexico killed 95·2 per cent. of *Diaphania hyalinata*, L., but less than 80 per cent. of *Laphygma frugiperda*, S. & A., and *Plutella maculipennis*, Curt. The other dusts of *P. erosus* killed

up to 88 per cent. of the first two of these insects and in some cases of one or two others. *P. palmatilobus* killed 76 per cent. of *D. hyalinata* and 80 per cent. of *L. frugiperda*. None of the dusts was toxic to adults of *Andrector* (*Cerotoma*) *ruficornis*, Ol. The mature fruit (seeds in pods) of *Aeschynomene sensitiva* killed 82 per cent. of *D. hyalinata*, but was not toxic to *L. frugiperda* or adults of *Andrector* [*cf.* **34** 218]; a dust of sugar-cane bagasse of the same fineness impregnated with derris extract to contain 0·25 per cent. rotenone killed 26 per cent. of *D. hyalinata* and 13 per cent. of *L. frugiperda* but no adults of *Andrector*. The seeds of *Calopogonium coeruleum* killed 63 per cent. of *L. frugiperda* and 26 per cent. of *D. hyalinata*, but were also non-toxic to adults of *Andrector*; the pods showed a maximum toxicity of 35 per cent. Immature and nearly ripe fruits of *Gliricidia sepium* gave less than 18 per cent. mortality, and a mixture of seeds and hulls (2 : 8) and the hulls, leaves, bark and wood of *Calophyllum antillanum* not more than 40 per cent. The bark of *Canella winteriana* killed 64 per cent. of adults of *Andrector*, but the wood was ineffective against this insect and all others tested. Immature and ripe fruits of *Cassia alata* killed 46 and 58 per cent., respectively, of *D. hyalinata*; the leaflets, petioles, bark and wood of this plant and of *C. spectabilis*, and the immature and ripe fruits and leaves of *Solanum ciliatum* were practically inert. Powdered mature seeds of *Mammea americana* and a powdered mixture of the seeds and pods (1 : 1) of one variety of *Pachyrhizus erosus* killed up to 19 and 33 per cent., respectively, of *Dysdercus andreae*, L., when the stainers were rolled in the dust and subsequently confined with sliced pods of *Montezuma speciosissima*, while other parts of *Mammea americana*, the seeds of *Aeschynomene sensitiva*, parts of *Calophyllum antillanum*, the immature and nearly ripe fruits of *Gliricidia sepium* and other introductions of *P. erosus* showed little or no toxicity to *D. andreae* or *Calandra* (*Sitophilus*) *oryzae*, L., the latter being confined in jars containing 10 gm. maize thoroughly mixed with 0·1 gm. of dust.

Sprays of 8 lb. powdered seed of *Mammea americana* in 100 U.S. gals. water and of nicotine sulphate in water (1 : 800), both with the addition of 4 lb. powdered soap per 100 U.S. gals. as a spreader, and a spray of 4 lb. powdered soap per 100 U.S. gals. water alone, applied in February to potted cabbage plants, reduced Aphid populations by 72, 96 and 50 per cent., respectively, in four days. When applied to cabbage plants in the field, a freshly mixed dust of powdered seeds of *M. americana* and hydrated lime (9 : 1) appeared to be more effective than the mamey-seed spray against Aphids, but was inferior to the nicotine spray; populations of *Plutella maculipennis* were reduced by 48, 69 and 71 per cent. by the dust, seed spray and nicotine spray, respectively. Considerable injury to the leaves became noticeable on most sprayed plots on the second day after application, particularly on those receiving the seed spray; it was probably due to the reaction of the seed powder with the soap, as it did not occur on the dusted plants. Four applications at ten-day intervals of dusts diluted with lime or talc to contain 90 per cent. powdered seed of *M. americana* and a derris-talc dust containing 0·5 per cent. rotenone were not very effective against *P. maculipennis* on cabbage, but gave 42, 55 and 75 per cent. control, respectively, on broccoli, on which the larvae were more exposed. The poor result with the lime dust was probably due to hydrolysis of some of the toxic resins by the lime in the presence of dew on the plants; there was practically no decrease in toxicity to *P. maculipennis* when the two dusts of *M. americana* were tested dry in petri dishes at frequent intervals up to three months after mixing.

A kerosene extract of the seed of *M. americana*, prepared by soaking 8 oz. powder in 1 U.S. quart kerosene for 24 hours, with intermittent agitation, and then filtering, gave considerable kill of cockroaches, mainly *Periplaneta americana*, L., ants, mainly *Paratrechina* (*Prenolepis*) *longicornis*, Latr., undetermined flies and mosquitos and adults of *Kalotermes* (*Cryptotermes*)

brevis, Wlk. The extract contained only a small part of the active principle, since the marc was found to be nearly as toxic as the original powder.

In *Cinchona* **Insect Investigations** (pp. 29–30), H. K. Plank & H. F. Winters report that a species of *Tetranychus* attacked the underside of the leaves of small *Cinchona* seedlings in the greenhouse at Mayaguez in June and November. Severe feeding caused the leaves to wilt and die, but complete control was obtained by one application of dusting sulphur. *Anaphothrips orchidii*, Moult. [*cf.* **34** 218] appeared on the leaves of young seedlings in the greenhouse in October and was controlled by repeated applications of derris dust (about 1 per cent. rotenone) or nicotine sulphate (1 : 800) with 1 per cent. emulsifiable white oil; the former treatment was the more practicable. *Heliothrips haemorrhoidalis*, Bch., caused curling and dropping of the leaves of seedlings of *C. calisaya* in nursery beds at Maricao in September; older trees in the same area were also infested, and some partly defoliated. These two thrips and *Scirtothrips longipennis*, Bagn. [*cf.* **34** 218] were found in September and October on seedlings at Toro Negro. The same control measures and also a spray of 4 lb. tartar emetic and 16 lb. sugar per 100 U.S. gals. water were tested, and repeated applications of the derris dust gave the best results. *Myzus circumflexus*, Buckt., and *Toxoptera aurantii*, Boy., were present on the underside of the small centre leaves of 5–10 per cent. of the one-year-old seedlings at Maricao in late October, and caused the leaves to curl and wrinkle. Larvae of the Sphingid, *Xylophanes pluto*, F., were found feeding extensively on the margins of the leaves of seedling trees in the Maricao nursery at various times from May to December. They were not numerous, and damage was prevented by hand-picking.

In **Vegetable Investigations** (pp. 31–33), N. F. Childers, H. F. Winters, P. Seguinot Robles & H. K. Plank describe investigations on the vegetable varieties most suitable for cultivation at different altitudes in Porto Rico. In the course of these, it was observed that the most persistent insects at Mayaguez (50 ft.) were the diamond-back moth [*Plutella maculipennis*, Curt.] on cruciferous crops, Aphids on lettuce and cabbage, and cutworms and mole-crickets [*Scapteriscus vicinus*, Scud.] on nearly all seedlings. Damage from cutworms and mole-crickets was reduced to less than 1 per cent. by a mixture of Paris green and maize meal (1 : 30) placed in circles about the young plants or in strips adjacent to the rows. *Empoasca fabalis*, DeLong, was so injurious to beans that few varieties could be grown. At higher altitudes (up to 3,300 ft.), *P. maculipennis* was troublesome on crucifers, but was controlled by frequent spraying.

H. K. Plank, in **Insect Pests of Food Crops** (pp. 37–38), reports that damage attributed to *Perforadix sacchari*, Seín [*cf.* **19** 199] was observed on eight-months-old sugar-cane in December. It resembled that due to severe drought or dry top rot, the centre spindle of the plants being wilted or partly dry, the internodes at the top of the stalk abnormally shortened and the large roots often only a few inches long, with a number of smaller roots near the end. The stalks with shortened internodes could be pulled up easily, as though the roots had been severed by Lamellicorn larvae. Some varieties were less severely injured than others, and ratoon cane was not affected, possibly because the accumulation of leaves and trash from the previous crop about the base of the stools kept the cane in good condition by conserving soil moisture and also prevented the adults of the Pyralid from depositing eggs in situations in which the resulting larvae could develop and injure the roots sufficiently for leaf symptoms to appear at this time. Leaving or placing trash about the base of the cane stool might be an important method of control.

In **Insect Parasites and Predators** (p. 39), H. K. Plank & K. A. Bartlett report on beneficial insects introduced into Porto Rico from São Paulo, Brazil, during the year. Parasites of *Diatraea saccharalis*, F., included 400 examples of *Telenomus alecto*, Crwf., which is already established in Porto Rico, and about

800 of a species of *Trichogramma*, probably *T. minutum*, Ril., all of which were obtained from 250 egg-masses of the moth and liberated near Hormigueros, and puparia of *Theresia claripalpis*, Wulp (*Paratheresia diatraeae*, Brèth.), *Parthenoleskia parkeri*, Tns., and *Metagonistylum minense*, Tns. (São Paulo strain) and cocoons of a species of *Ipobracon*, from which 1,128, 11, 46 and 23 adults, respectively, were reared and liberated, after mating, at Hormigueros between 28th February and 24th May. The emergence of the fly parasites was very low, as most of the material was field-collected and heavily infested by hyperparasites ; one sample showed over 40 per cent. of the puparia attacked. A large shipment of coffee leaves infested by *Coccus viridis*, Green, gave rise to 1,103 adult females and 296 males of *Coccophagus caridei*, Brèth. (*heteropneusticus*, Comp.) and four females and one male of *C. fallax*, Comp., as well as numerous hyperparasites, which were destroyed. Between 27th January and 16th February, 1,035 females and 286 males of *C. caridei* and three females and one male of *C. fallax* were liberated near Mayaguez. Some examples of a Coccinellid of the genus *Azya* that is predacious on *Coccus viridis* in São Paulo were also introduced ; the parasites that emerged from the pupae were destroyed, and the 23 surviving beetles were caged for reproduction and colonisation on gardenia infested by *C. viridis* at Mayaguez. In addition, a shipment of *Chilocorus stigma*, Say, which is predacious on the bamboo scales, *Asterolecanium bambusae*, Boisd., and *A. miliaris*, Boisd., was received from Florida, and 233 were liberated at Mayaguez in July.

In **DDT Investigations** (pp. 39–40), H. K. Plank describes preliminary tests on the use of DDT to control *Anastrepha mombinpraeoptans*, Seín, which reduces the crop of many of the best varieties of mango in Porto Rico. A stock emulsion prepared by dissolving 1 lb. commercial DDT in 1 U.S. gal. soy-bean oil and emulsifying it with 1 lb. soy-bean flour in about ½ U.S. gal. water was diluted with water to make 100 U.S. gals. and applied to trees of two very susceptible varieties in March. The diluted spray was a fairly quick-breaking emulsion that spread well over fruit, leaves and bark. The stock kept well for two days at about 28–30°C. [82·4–86°F.] ; fermentation and some separation then became evident, but did not impair the quality or interfere with re-emulsification. Observations on 30th April showed that infestation on one variety was considerably reduced, but control was variable and inconclusive on the other.

In **Curing Experiments** (p. 42), D. G. White, P. Seguinot Robles & M. Cobin describe tests on the effect of the age of bamboo when cut and the method of treating it after cutting on infestation by *Dinoderus minutus*, F. Culms that sprouted in 1943, 1942, 1941 and 1940 from clumps of *Bambusa tuldoides* planted in 1936 were cut above the second node in January 1944, when they were approximately 6, 12–18, 24–30 and 36–42 months old, respectively, and either trimmed and stored immediately on horizontal racks under an open shed ; maintained upright in field clumps for 28 days and then trimmed and stored (clump cured) ; trimmed and submerged in a pond for periods of 130, 161 or 192 days and then stored (water cured) ; or clump cured for 14 days, water cured for 135 days and then stored. All were cut into 12-feet lengths at the time of storage. Counts, made monthly for six months during storage, of the numbers of holes made by *D. minutus* showed that culms that were merely stored under a shed were significantly more infested than those receiving the other treatments, of which clump curing gave the best practical results, though the differences between them were not significant. Infestation in culms produced in 1940 was significantly less than in those produced in 1941 and 1942 and significantly greater than in those produced in 1943. There were several highly significant differences between treatments within the 1941 and 1942 ages and between ages within each treatment. The basal 12-foot sections had significantly more infestation than the middle sections and these significantly more than the tips [*cf.* **32** 344].

In **Bamboo Powder-post Beetle** (p. 43), H. K. Plank describes tests on the relative susceptibility to *Dinoderus minutus*, F., of culms of *Bambusa vulgaris* and *B. tulda* that sprouted in 1939–43, in which ¾-inch rings from internodes at the base, middle and top of the culms were exposed in cages to infestation by six adults per ring. *B. vulgaris* sustained an average of 8·55 attacks per ring and *B. tulda* 1·25. At each age in both species there were more attacks in the rings from the bottom internodes than in those from the middle and fewest in those from the top, but in *B. tulda* none of the differences was significant. The distribution of starch in the samples, as shown by the iodine test, corresponded in general to the intensity of infestation. Samples of *B. vulgaris* showed medium to strong concentrations of starch in the wood, but those of *B. tulda* showed little or none. In any one position in either species there was little difference in reaction among the various ages, fifth-year wood showing nearly as much starch as first-year wood. At each stage of growth, there was a highly significant difference in susceptibility between species, but among ages of either species not all differences were significant. The susceptibility of *Bambusa vulgaris* decreased significantly with each year of age except between the third and fourth years, and the number of attacks on the oldest culms of this species was nearly as low as that in first-year culms of *B. tulda*. The older culms of *B. tulda* were all less susceptible than the first-year stock, but the difference was significant only in the second- and fifth-year culms. It is concluded that much of the damage caused by *D. minutus* could be avoided in *B. vulgaris* by not harvesting culms before their third year of growth and in *B. tulda* by not harvesting before the second year.

McDuffie (W. C.). **The Legume Weevil** *Hypera brunneipennis* **(Boh.) during the Season of 1941–42.**—*Spec. Publ. Calif. Dep. Agric.* no. 209 pp. 27–28. Sacramento, Calif. [1945.]

Observations on *Hypera brunneipennis*, Boh., in the Yuma Valley of Arizona [*cf. R.A.E.*, A **31** 510] were continued until the end of April 1942, when the Station was closed. The seasonal activities of the weevil from July 1941 to April 1942 followed practically the same course as in previous years [*cf. loc. cit.*], but cold weather in December and January resulted in an accumulation of unhatched eggs that reached a maximum at the beginning of February. The growth of sour clover [*Melilotus indica*] was early and vigorous, and 64 per cent. of the eggs on it were in the growing stems as compared with only 41 per cent. in the preceding year. Mortality of larvae was, as usual, very high and production of adults negligible on lucerne, but though larval mortality on sour clover was higher than in the preceding year, about the usual number of adults matured on it. Damage was again confined to a few areas of self-sown sour clover. In further food-plant studies [*cf.* **31** 511], larvae fed and pupated on Hubam clover [a variety of *Melilotus alba*], Egyptian clover [*Trifolium alexandrinum*] and yellow-flowered sweet clover [*M. officinalis*], but none of four varieties of peas was infested under field conditions, and it appears unlikely that they will ever be attacked.

Limited numbers of the parasite, *Bathyplectes curculionis*, Thoms., were liberated in the Yuma area in spring, but none was recovered. The rearing of larvae and pupae and incubation of eggs from field samples failed to reveal the occurrence of any native parasite. Observations on cutting sour clover as a control measure indicated that practically no larvae survived in areas from which the growth was removed in February, but cutting a perennial leguminous plant, such as lucerne, when the larvae were present would not be likely to give effective control owing to the presence and hatching of eggs in the litter of dried stems on the ground over a considerable period and the immediate recurrence of new growth of the plants. Experiments in which adult weevils were

introduced into sacks of flax seed showed that small numbers could survive for several months in the sacks, but the few adults active in the field in June, when the crop is harvested, are apparently incapable of reproduction or long survival; there is practically no danger of infestation in recleaned lucerne seed.

MACKIE (D. B.). **Potato Tuber Moth with special Reference to its Quarantine Aspects.**—*Spec. Publ. Calif. Dep. Agric.* no. 209 pp. 36–43, 2 figs. Sacramento, Calif. [1945.]

In the course of this discussion of the various internal quarantines relating to the potato tuber moth [*Gnorimoschema operculella*, Zell.] in the United States, which was read at a conference of the Western Plant Board held in 1942, it is pointed out that the local distribution and importance of the moth are not well known. It is apparently seldom if ever injurious to potatoes in the field in California, Texas and Florida, where it is a pest of the stored tubers, while observations in the Mississippi Valley and in such States as Iowa and Nebraska show that it occurs there as a leaf-miner and is of no significance. It appears to have reached the limits of its distribution in California, where several important potato-producing areas are exempt from infestation. The larvae do not survive in tubers stored at 38–40°F.

WHEELER (E. H.). **Why the Oriental Fruit Moth was bad in 1945 and what to do in 1946.**—*Proc. N.Y. St. hort. Soc.* **91** pp. 11–17. Le Roy, N.Y., 1946.

Injury by the oriental fruit moth [*Cydia molesta*, Busck] to mid-season and late peaches in New York State in 1945 was the heaviest yet recorded, since its parasites failed to check it. This failure is attributed primarily to the small numbers of the introduced parasite, *Macrocentrus* [*ancylivorus*, Rohw.], that survived the winter, and to the abnormal spring weather in 1945. The scarcity of overwintering parasites was due to low populations of *C. molesta* in the autumn of 1944, which in turn resulted from heavy parasitism among twig-infesting larvae of the first and second generations and early hardening of the terminal twigs of peach due to hot, dry weather, and to the absence of any suitable alternative host. Mild weather from mid-March until mid-April 1945 caused adults of at least one of the two important native parasites to appear before the host larvae were available, and this species was absent from collections of larvae made later in the summer; adults of *M. ancylivorus* probably also emerged prematurely. Severe weather from mid-April to mid-June prevented the moths from ovipositing and such eggs as were deposited from hatching. Parasitism among the first-generation larvae was 10–20 per cent. lower than in the previous year, and favourable weather when moths of the first and second generations were ovipositing enabled injurious populations to be built up.

An account is given of an experiment in which *C. molesta* was satisfactorily controlled by spraying with DDT [*R.A.E.*, A **35** 258], and the relative merits of control by this material and by parasites are discussed. It is pointed out that other factors beside the relative cost must be considered in deciding whether to resort to spraying. Twig-infesting larvae were more numerous than usual in September 1945 and were heavily parasitised, and parasitism among fruit-infesting larvae reached 15–20 per cent. The prospects for adequate parasite populations in the early summer of 1946 were therefore good. Imperfectly timed or applied sprays can destroy most of the parasites present and still not prevent heavy injury by *C. molesta*, and if the parasites are eliminated by the spray, its use must be continued unless some means of re-introducing them in large numbers is available. In the spraying experiment, a residue of

0·043 grain DDT per lb. fruit was found 28 days after the last application, when the fruit was harvested. This was just within the legal tolerance (0·05 grain), but residues immediately after the last application were three times greater than the tolerance, and care must therefore be taken to avoid excessive residues in mixed plantings containing early, mid-season and late varieties.

BARNES (M. M.). **Experiences with a Spray Attachment to a standard type Orchard Duster.**—*Proc. N.Y. St. hort. Soc.* **91** pp. 152–155. Le Roy, N.Y., 1946.

Dusts are easy to apply in orchards but have poor powers of adhesion in unfavourable weather. Since it was thought that both the amount deposited and its adhesion would be improved by wetting the dust, a spray unit that was fitted to standard dusting equipment for this purpose was devised and tested against the codling moth [*Cydia pomonella*, L.] on apple in western New York in 1945. The spray unit comprised a power-driven pump operated at 400 lb. pressure and fed from a tank provided with an agitator. A hose line led from the discharge outlet of the pump to a quick cut-off valve mounted near the lever that shut off the dust supply, and a hose led from this valve to a head of nozzles attached to the dust outlet. The head most extensively used comprised four spray broom inset nozzles on ¼-inch pipe fittings clamped to the metal dust outlet. A set of disks was used of a size to discharge enough liquid to wet a large proportion of the dust without causing appreciable run-off, except when the branches were close to the outlet. The nozzles were level with the end of the outlet and inclined into the dust stream at an angle of about 15° from parallel. Spray cone angles of about 25° produced by means of six-hole whirl plates formed converging patterns that effectively screened the dust outlet.

In the tests, three cover applications were made, on 24th June and 4th and 16th July, against the first generation, and one on 16th August against the second, and ½ pint of a vegetable oil per 100 gals. was added as a spreader and sticker to the water used to wet the dust. The results showed that the percentages of apples infested and (in brackets) superficially injured were 0·4 (3·3) for 5 per cent. DDT and 5 per cent. talc in micronised sulphur, 2·7 (9·6) for 20 per cent. lead arsenate in micronised sulphur, between the two for a dust mixture containing less DDT with nicotine and oil and also for a standard spray schedule of lead arsenate against the first generation and fixed nicotine against the second, applied on the same dates, and 31·6 (10·9) in the controls. The European red mite [*Paratetranychus pilosus*, C. & F.] did not build up on trees dusted with DDT. It was found that about 1 U.S. gal. liquid was required to wet 1–1¼ lb. dust. The pump delivered 4–5 U.S. gals. per minute at 300–400 lb. pressure. The amount of dust needed per tree was reduced by about 20 per cent. by the use of this equipment and one less cover application was made than with the normal dust schedule, resulting in a total reduction of 33 per cent. in the amount of materials used during the season. Infestation was light, however.

BRANN jr. (J. L.). **The Use of DDT Sprays for Codling Moth Control.**—*Proc. N.Y. St. hort. Soc.* **91** pp. 193–199. Le Roy, N.Y., 1946.

Observations on the relative effectiveness against the codling moth [*Cydia pomonella*, L.] of sprays containing DDT in various combinations, their effect on the foliage and fruit and the residues left at harvest were made in two heavily infested apple orchards in New York in 1945. Six cover sprays were usually applied and the results are shown in tables and discussed.

The control given by a wettable powder containing 50 per cent. DDT micronised with pyrophyllite increased when the actual amount of DDT per 100 U.S. gals. rose from ½ to 1 and 2 lb. (77·1, 87·2 and 95·2 per cent. uninjured fruit as compared with 3·3 per cent. for no treatment and 35·1 per cent. for

3 lb. lead arsenate per 100 U.S. gals.), but the amount of visible and toxic residue at harvest was also increased ; it is thought that a concentration of 1 lb. actual DDT, which left a toxic residue just over the tolerance of 0·05 grain per lb. fruit, should be satisfactory. The control given when fuller's earth was substituted for the pyrophyllite was slightly inferior. A proprietary spray preparation containing 33·3 per cent. DDT dissolved in a synthetic organic oil-like material compatible with sulphur, which was emulsified in the spray tank, gave similar control, left no visible residue and did not injure the trees, but the toxic residue considerably exceeded the tolerance. The addition of blood albumin as a spreader and sticker to the DDT-pyrophyllite did not affect control, but reduced the residue considerably and rendered it practically invisible. The inclusion of summer oil in this mixture in cover sprays 3–6 did not affect control, but increased both toxic and visible residues and caused scorching of the leaves. When the DDT-pyrophyllite was used in cover sprays 3–6 to fortify lead arsenate, nicotine sulphate and oil, the oil caused a high toxic residue and scorching of the foliage, but excellent control was obtained with only a moderate amount of visible residue. A proprietary preparation containing 25 per cent. DDT and 50 per cent. xanthone (Genicide-DDT) and one containing 17 per cent. DDT and 7 per cent. fixed nicotine (Black Leaf 155-DDT) gave good control, did not injure the foliage, and left a toxic residue that was within the tolerance, but both left visible residues. Another containing 17 per cent. DDT on tobacco residues from which most of the nicotine had been removed, applied at a concentration of ½ lb. DDT per 100 U.S. gals., gave control comparing favourably with that of other preparations in which DDT was used at the same concentration and left no objectionable residues, but seriously injured the foliage when combined with sulphur in the first cover spray. Two proprietary powders containing 25 and 40 per cent. DDT (Deenate 25 W and Gesarol AK40) gave excellent control at 1 lb. DDT per 100 U.S. gals., but both left heavy visible residues and are therefore unsuitable for use against the second generation ; the toxic residues left by both were above tolerance, that by the second being the higher. A schedule in which the DDT-pyrophyllite was combined with lead arsenate (½ lb. DDT per 100 U.S. gals.) in cover sprays 1, 2 and 4 and used alone (1 lb.) in cover sprays 3, 5 and 6 gave satisfactory control ; the toxic residues were slightly below tolerance for lead and arsenic and rather above for DDT, but the visible residue was heavier than is desirable on high quality fruit, especially if it cannot be removed by brushing.

It is concluded that DDT in the form of a wettable powder gives excellent control, but leaves excessive toxic and visible residues ; much of the latter is due to the inert carriers and can be reduced by using powders containing at least 50 per cent. DDT.

HAMILTON (D. W.). **Tests of Dusts for Codling Moth Control in 1945.**—*Proc. N.Y. St. hort. Soc.* **91** pp. 200–205, 2 refs. Le Roy, N.Y., 1946.

In view of the satisfactory results given by a DDT dust against the codling moth [*Cydia pomonella*, L.] on apple in small-scale tests in eastern New York in 1944 [*R.A.E.*, A **34** 197], more extensive tests were made in 1945, when dusts containing 5 per cent. DDT were compared with dusts of lead arsenate and phenothiazine and with the recommended spray schedule. The dusts were applied six times between 2nd June and 6th–7th July against the first generation and three times between 6th and 20th August against the second ; each tree received 2–3 lb. Talc (with 40 per cent. micronised sulphur as a fungicide in the first application) was the diluent for all dusts except one of those containing lead arsenate, and 2 per cent. dormant oil with a viscosity of 100 Saybolt was added to all except one of those containing DDT. The spray

schedule comprised 3 lb. lead arsenate and 3 lb. lime per 100 U.S. gals. for the first, second and fourth cover sprays, supplemented by ½ U.S. pint nicotine sulphate in the first and second, and ½ pint nicotine sulphate and 2 quarts oil emulsion per 100 gals. for the third, fifth and sixth.

The percentages of apples undamaged at harvest were 86 for the spray schedule, 94 and 91 for DDT with and without oil in the dust, 90 for 20 per cent. phenothiazine, 92 for a mixture of 10 per cent. phenothiazine and 20 per cent. lead arsenate, 67–68 for 20 per cent. lead arsenate, with sulphur, talc or talc and 10 per cent. lime as the diluent, 76 and 77 for 25 and 30 per cent. lead arsenate, and 76 and 80 for 20 per cent. lead arsenate with the addition of 10 and 20 per cent. nicotine bentonite containing 14 per cent. fixed nicotine. The DDT residues were less than 0·01 grain per lb. fruit, and the appearance of the fruit was superior to that from other plots. The mixture of phenothiazine and lead arsenate, unlike the other lead-arsenate dusts, caused no arsenical scorching and it was less expensive than 20 per cent. phenothiazine alone. The leaves of trees treated with phenothiazine were a good colour and there was little deposit on the fruit at harvest. The stronger lead-arsenate dusts and those containing nicotine bentonite or lime left lead residues that exceeded the legal tolerance, and the visible deposits on the apples dusted with lead arsenate were heavier than on those dusted with DDT.

Dean (R. W.). **Effect of DDT on Apple Maggot, Red Mite and Curculio.**—*Proc. N.Y. St. hort. Soc.* **91** pp. 205–209. Le Roy, N.Y., 1946.

The author discusses the effects on other pests on apple in New York of spray schedules including DDT applied against the codling moth [*Cydia pomonella*, L.]. In a test in 1944, 0·4 lb. DDT per 100 U.S. gals. in the calyx, curculio and first cover sprays failed to control the plum curculio [*Conotrachelus nenuphar*, Hbst.], and although indications were obtained in 1945 that DDT may have some effect against this weevil, lead arsenate (3 lb. per 100 U.S. gals.) should for the present be included in the first cover spray, which is the first application in which the use of DDT against *Cydia* is suggested. The action of DDT spray deposits on adults of the apple maggot [*Rhagoletis pomonella*, Walsh] was slow in preliminary laboratory tests, but more rapid when the flies were kept more continuously in contact with the sprayed surfaces. The action of dust deposits was still faster, especially when the rate of application was high ; toxic symptoms appeared within 15 minutes and all but the lightest applications caused complete mortality in 28 hours or less. In field tests in 1944, a spray containing 1 lb. DDT per 100 U.S. gals. applied on 22nd June and again on 14th July gave fairly good control, but a single application on 23rd June was insufficient. The use of 1 lb. DDT per 100 U.S. gals. in the second, third and fourth cover sprays gave good control on a moderate infestation in 1945. DDT is too expensive to apply against *Rhagoletis* alone, but might be justified to obtain a rapid kill of flies migrating into an orchard or to avoid arsenical residues on early varieties. Where it is being used against *Cydia* in at least the second, third and fourth cover sprays, it should give a satisfactory control of *Rhagoletis*.

During two years of extensive tests in the Hudson Valley, no outbreak of the European red mite [*Paratetranychus pilosus*, C. & F.] occurred on trees sprayed with DDT. In 1945, the mite increased during June in an untreated plot and, to a less extent, in one sprayed with DDT at 0·8 lb. per 100 U.S. gals., and then decreased until August when its numbers were very low ; they began to increase again in the treated plot in September, but at their peak in early October were only 33 per cent. of the initial population and so were of no importance. Some control factor other than natural enemies was evidently operating, since these disappeared from both treated and untreated plots soon after spraying began. As a precaution, it is advisable to apply a delayed dormant oil spray at a concentration of 3 per cent. where DDT is to be used in subsequent sprays, and

further measures should be applied if mite populations build up during the summer. In the only instance seen of increase of mites following the use of DDT sprays, the mite concerned was *Tetranychus* sp., which had not previously been observed by the author on fruit trees but may be of potential importance where DDT is used.

PIÉDROLA GIL (G.). **Nuevos insecticidas y ahuyentadores : su estudio, importancia y técnicas de empleo.** [New Insecticides and Repellents : their Study, Importance and Modes of Use.]—247 pp., 35 figs., 6 graphs, many refs. Madrid, Inst. esp. Med. colon., 1947. Price 75 *ptas.*

This book, although primarily concerned with the use of DDT and benzene hexachloride against pests of medical importance, includes chapters on their chemistry and development, their mode of action and its biochemical interpretation, the symptoms produced in insects and mammals, and the analysis and evaluation of proprietary preparations. Their uses in agriculture and against pests of stored products are briefly discussed in a final chapter.

HÄFLIGER (E.). **Beitrag zur Biologie und Bekämpfung der Azaleenmotte *Gracilaria azaleella* Brants.** [A Contribution to the Biology and Control of the Azalea Moth.]—*Mitt. schweiz. ent. Ges.* **20** pt. 2 pp. 141–160, 3 figs., 6 graphs, 18 refs. Berne, 1946. (With a Summary in French.)

The results are given of investigations in Switzerland on the bionomics and control of *Gracilaria azaleella*, Brants, on azalea. In the laboratory, the moths emerged mostly at about noon and were active only at night. The preoviposition period lasted 3–4 days, and pairing usually occurred during the second night after emergence. The eggs were laid singly on the undersides of the young leaves, usually 1–5 on each [*cf. R.A.E.*, A **15** 118]. Females laid an average of 106 eggs each, mostly during the first week after emergence, and males and females survived for averages of 16 and 12½ days, respectively. The threshold of development for the eggs was calculated to be about 7°C. [44·6°F.], but appeared to be a little higher ; at a greenhouse temperature of 20–25°C. [68–77°F.], hatching occurred in 5–8 days. After mining and rolling the leaves [*cf.* **22** 271], the larvae pupate in cocoons in rolled leaves ; at 17°C. [62·6°F.], the adults emerged after about 16 days. In the greenhouse, development lasts about 70 days, so that there may be 4–5 overlapping generations a year, but these will be fewer in the open.

Experiments on control were carried out with Gesafid (an emulsible preparation containing 20 per cent. DDT), which, when diluted with water to a concentration of 0·25 per cent. (0·05 per cent. DDT) left no visible traces on the plants. When azalea twigs bearing leaves infested with eggs of *G. azaleella* of various ages were dipped for 1–2 seconds in Gesafid at this dilution and examined ten days later, only half the expected number of larvae could be found. About 90 per cent. of these were dead in short mines in the leaves, or still on the surface, and about 10 per cent. were alive in longer mines. Since nearly all the eggs hatched on untreated plants, it is thought that the missing larvae must have fallen from the leaves soon after contact with the deposit.

Further tests having shown that open blossoms and leaves of azalea are not injured by Gesafid at concentrations of up to 0·5 and 1 per cent., respectively, and that treatment with 0·25 per cent. Gesafid caused the larvae to emerge from the rolled leaves, an experiment was carried out in a greenhouse in February 1946, in which two varieties of azalea were sprayed with 0·25 per cent. Gesafid. Most of the larvae left their shelters during the following six days and were found paralysed or dead on or near the pots ; very few were still able

to crawl, and 90 per cent. of those that were placed on an untreated surface with untreated food died. On the sixth day after treatment, when all the 190 shelters were opened, only four living and five dead larvae were found in them, together with 12 pupae, whereas only living larvae and pupae were found on untreated plants.

Newly emerged adults that were exposed for 1–2 seconds to a wet deposit of 0·25 per cent. Gesafid in petri dishes and then placed on an untreated surface were lying on their backs after 1½–2 hours and did not subsequently recover. When confined with a dry deposit, they became paralysed in an average of 11 hours. It is concluded that the moth could be eliminated from a greenhouse by treating the plants with Gesafid and spraying the whole interior of the greenhouse, so that no untreated surface remains.

BARANYOVITS (F.). **Der Erbsenkäfer** (*Bruchus pisorum* **L.).** [The Pea Beetle.] [*In Magyar.*]—*Növényegészségügyi Évkönyv* (Yearb. off. phytosanit. Serv.) **2–4** pp. 208–276, refs. Budapest, 1944. (With a Summary in German, pp. 259–272.)

In this detailed summary of a paper of which the original has not been received, all stages of *Bruchus pisorum*, L., are described, and an account is given of observations on its bionomics and control in Hungary, where it has caused losses of 3–45 per cent. of the pea crop for several years. Some of the information on its bionomics has been noticed from an earlier paper by the author [*R.A.E.*, A **24** 269]. In 1943, the first flights of adults were observed early in April, at a temperature of 14°C. [57·2°F.]. The egg, larval and pupal stages lasted 5–8, 35–45 and 7–12 days, respectively, and there is normally only one generation a year. Brindley's observations on the number of eggs laid and the survival of only one individual in a seed [*cf.* **22** 92] are confirmed. Large seeds did not give rise to abnormally large adults, but the few small individuals that were observed all emerged from small, stunted seeds.

At harvest, the larvae have reached only the second or third instar, so that much of the damage is done in the harvested peas. If the peas are threshed soon after ripening, while the larvae are still present, and are stored in a cool place, few adults emerge in autumn, but if they are threshed late, after the adults have matured, many of the latter escape during the process. The remaining adults leave the peas in late spring, when the storehouses become warmer. Adults that overwinter in the open do so in cracks in buildings, wooden fences, the bark of trees and other sheltered places, but not in the soil. The maximum period for which adults survived was 14–16 months, and none overwintered more than once [*cf.* **23** 644].

The survival of individuals in seed that falls to the ground at harvest depends chiefly on the weather. If the soil is dry and no rain falls for a fortnight, the adults complete their development and emerge at once, but if the soil is damp or rain falls, so that germination begins, the development of the larvae is retarded or completely arrested. If rain falls after the larvae have pupated, the adults emerge late. If infested seed is ploughed deep into the soil, where there is usually enough moisture to promote immediate germination, bacteria and fungi attack it and prevent the larvae from completing their development, but if the pupal stage has been reached, some adults may emerge after the seed and soil have dried. Adults emerge almost at once when infested peas are sown in spring, but if rain falls immediately after sowing, they are unable to leave for 2–3 days. If the soil remains damp for a long period, most of the beetles in the seed are killed. Living beetles have been found in seed with shoots about an inch high, but such examples are too weak to leave the seed.

In laboratory experiments, adults taken from peas that had been steeped in water for 72 hours revived in a few hours. When infested seed was sown in

spring in soil that was dry, damp or wet, 4 per cent. of the beetles appeared in 24 hours from the dry soil, all from the damp soil and none from the wet soil ; no more emerged from the dry soil, whereas up to 60 per cent. emerged from the wet soil after it had been allowed to dry for 4–8 days. It is concluded that the physical change in the seed brought about by the absorption of a small amount of moisture causes the beetle to leave it immediately, but if the moisture is sufficient to exclude all air from the seed, it is unable to do so.

In 1936, 25·2 per cent. of the eggs of the Bruchid in an experimental plot were parasitised by *Uscana semifumipennis*, Gir., which the author bred for several generations in eggs of *B.* (*Acanthoscelides*) *obtectus*, Say. The larvae were parasitised by *Triaspis* (*Sigalphus*) *thoracicus*, Curt., and *T.* (*S.*) *gibberosus*, Szépl. ; *T. thoracicus* was the commoner, but, on the whole, not more than 1 per cent. of the larvae are parasitised. The mite, *Pediculoides* (*Pediculus*) *ventricosus*, Newp., occasionally attacked the larvae or pupae.

It has been suggested in the literature that infestation can be reduced by late sowing, but this is effective only if early varieties are also sown to attract the ovipositing females, and is impracticable in Hungary, where for climatic reasons the main crop must be sown as early as weather permits. In experiments on the control of the adults on the plants, a spray of nicotine and soap was of little value, and rotenone dusts, though effective, were too expensive. A DDT dust (Gesarol) proved very effective in 1943, killing all adults that came in contact with it. Two applications are recommended, the first as soon as the first blossoms have fallen, and the second 5–6 days later. Since infested seeds that fall from the pods during harvest provide one of the main sources of infestation for the following year, the peas should be picked as carefully as possible, and varieties in which the pods tend to open readily avoided. Seeds that have fallen to the ground should be ploughed deep into the soil.

The harvested peas should be fumigated as soon as possible to prevent further damage. Carbon bisulphide was formerly used for this purpose in Hungary, but since 1943 it has been replaced by Ventox [acrylonitrile] which is effective and easy to apply and does not injure the peas ; a concentration of 1 oz. per 100 cu. ft. gives complete mortality in eight hours at a temperature of at least 20°C. [68°F.], but 1·5–2 oz. per 100 cu. ft. for 20 hours is recommended since gas-tight conditions are difficult to obtain on farms. The liquid is applied in a shallow dish just below the ceiling, and the peas should be in bags raised from the ground and stacked crosswise at least 4 ins. from the walls and from one another to not more than two-thirds of the height of the fumigation chamber. In 1938, measures for the control of the Bruchid were made compulsory in Hungary, and 200 fumigation chambers have been erected for the use of growers.

Baranyovits (F.). **Schädlinge des ungarischen Rizinusanbaues.** [Pests of Castor in Hungary.] [*In Magyar.*]—*Növényegészségügyi Évkönyv* (Yearb. off. phytosanit. Serv.) **2–4** pp. 384–385, 2 refs. Budapest, 1944. (With a Summary in German.)

Insect damage to castor [*Ricinus communis*] had been unknown in Hungary until 1943, when larvae of *Agrotis segetum*, Schiff., killed a number of plants by severing the stems. Effective control was obtained in 2–3 days by means of baits of bran moistened with molasses solution and poisoned with cryolite, which were scattered over the soil in the evening. In June 1943, the leaves, and occasionally the stems, of small plants were damaged by *Tanymecus palliatus*, F., and *Psalidium maxillosum*, F. Although as many as four of these weevils were found sheltering just below the surface of the soil near each plant during the warmer parts of the day, the damage was only 4–5 per cent. over the whole field. Neither DDT (Gesarol) nor arsenicals gave satisfactory control.

BARANYOVITS (F.). *Etiella zinckenella* **Treit., als Erbsenschädling.** [*E. zinckenella* as a Pest of Peas.] [*In Magyar.*]—*Növényegészségügyi Évkönyv* (Yearb. off. phytosanit. Serv.) **2–4** p. 386. Budapest, 1944. (With a Summary in German.)

Damage to peas in Hungary amounting to 1–6 per cent. of the crop is caused by *Etiella zinckenella*, Treitschke ; the wide distribution of this Pyralid is favoured by the abundance of acacia [? *Robinia pseudacacia*], its chief food-plant, 70 per cent. of the pods of which were frequently found infested. The injury to peas is similar to that caused by *Tychius quinquepunctatus*, L., which attacks 1–3 per cent. of the seeds, but while *Tychius* often penetrates into them *Etiella* usually feeds superficially.

BARANYOVITS (F.). **Ein für Ungarn neuer Luzerneschädling** (*Clytus* (*Plagionotus*) *floralis* **Pall.**). [A new Pest of Lucerne in Hungary, *Plagionotus floralis*, Pall.] [*In Magyar.*]—*Növényegészségügyi Évkönyv* (Yearb. off. phytosanit. Serv.) **2–4** pp. 386–389, 5 refs. Budapest, 1944. (With a Summary in German.)

In the autumn of 1936, lucerne plants in a field in southern Hungary were killed by Cerambycid larvae, which tunnelled in the roots and lower parts of the stems. Examples collected in the field gave rise early in the following summer to adults identified as *Plagionotus* (*Clytus*) *floralis*, Pall. Adults appeared in the field in late May or early June ; the eggs were usually laid singly, near the plants, in holes in the soil made by the female, or, if the soil was hard, in cracks. In the laboratory, one female laid 24 eggs in three days ; eggs laid on 21st June hatched on 6th July and the young larvae crawled to lucerne plants and tunnelled into the roots and stems. In the field the Cerambycid overwintered in the larval stage and pupated in spring in the roots and stems. Only lucerne plants that were more than four years old were attacked, and as these are rare in Hungary, little damage is likely to be caused.

BARANYOVITS (F.). **Angaben zur Biologie und Bekämpfung des Rübenkäfers.** [Data on the Biology and Control of the Beet Weevil.] [*In Magyar.*] —*Növényegészségügyi Évkönyv* (Yearb. off. phytosanit. Serv.) **2–4** pp. 389–395, 1 graph, 7 refs. Budapest, 1944. (With a Summary in German.)

The author concludes from field observations that the chief pests of sugar-beet in Hungary are the weevils, *Cleonus punctiventris*, Germ., *Tanymecus palliatus*, F., and *Psalidium maxillosum*, F., of which the last is the least important. *Otiorrhynchus ligustici*, L., which is often found in beet fields and has been recorded as a serious pest of beet [*cf. R.A.E.*, A **22** 246], prefers the leaves of lucerne and only feeds on beet leaves in case of need. *O. orbicularis*, Hbst., which is rarer, also prefers lucerne, but feeds on beet rather more readily than does *O. ligustici*. Of the Coleoptera collected in a beet field in southern Hungary on 1st May 1944, 63 per cent. were *C. punctiventris* and 23, 12 and 1 per cent. were *T. palliatus*, *Opatrum sabulosum*, L., and *Otiorrhynchus ligustici*, whereas on 23rd May, these species represented 35, 4, 0·5 and 60 per cent., respectively, of the total. Adults of *C. punctiventris* were observed in flight in favourable weather.

In control experiments with various insecticides, sprays of barium chloride or arsenicals were less effective against the adults of *C. punctiventris* than sprays and dusts of Gesarol [which contains DDT] ; Gesarol dust at about 18 lb. per acre gave 22 per cent. mortality in two days and 82 per cent. in six days, and sprays of 1, 1·5 and 2 per cent. Gesarol gave 11, 14 and 17 per cent. mortality, respectively, in two days and 45, 62 and 80 per cent. in six days. The spray is preferred to the dust, as it is more economical in use and less susceptible to weathering.

Baranyovits (F.). **Welche Drahtwürmer sind in Ungarn schädlich ?** [Which Wireworms are injurious in Hungary ?] [*In Magyar.*]—*Növényegészségügyi Évkönyv* (Yearb. off. phytosanit. Serv.) **2–4** pp. 395–396, 3 refs. Budapest, 1944. (With a Summary in German.)

Wireworms cause severe damage to crops in Hungary. Of those collected since 1934 and reared in the laboratory, 80 per cent. were *Agriotes sputator*, L., 15 per cent. *A. ustulatus*, Schall., and 5 per cent. *Lacon murinus*, L., *Corymbites* (*Selatosomus*) *aeneus*, L., *A. lineatus*, L., and *A. obscurus*, L.

Soyka (W.). **Beiträge zur Klärung der europäischen Arten der Mymariden (Chalc. Hymen.). Das Genus *Polynema* Haliday.** [Contributions to the Clarification of the European Species of Mymarids. The Genus *Polynema*, Haliday.]—*Natuurh. Maandbl.* **30** no. 1 pp. 6–8. Maastricht, 1941.

This paper comprises a description of the adult female of *Polynema fulmeki*, sp. n., which was reared from *Quadraspidiotus* (*Aspidiotus*) *perniciosus*, Comst., in Austria in 1940 [*cf. R.A.E.*, A **31** 373], and a redescription of that of *P. laeta*, Först. The males of both are unknown.

Melis (A.). **Contributo alla conoscenza dell' *Aspidiotus perniciosus* Comst.** [A Contribution to the Knowledge of *Quadraspidiotus perniciosus*, Comst.] —*Redia* **29** pp. 1–170, 10 pls., 21 figs., 179 refs. Florence, 1943.

In view of the establishment of *Quadraspidiotus* (*Aspidiotus*) *perniciosus*, Comst., on fruit trees in Italy [*cf. R.A.E.*, A **33** 125 ; **35** 201], the author gives descriptions of all stages of this Coccid, including an apterous male, and an account of its bionomics and control based on the literature and on field and laboratory observations carried out in central Italy in 1942–43. There were in general five overlapping generations a year, the crawlers appearing in June, mid-July, August, mid-September and November, but some crawlers were produced during winter and may represent a sixth. Most of these winter crawlers died in the cold weather, but some entered diapause or developed very slowly. Winter was usually passed in the second instar, adult males and females appearing in numbers at the end of April and in May, respectively. Males were more numerous than females in the early generations, including the overwintering one, but less in the later. Females of the late summer generations on apple and pear fruits produced 32–190 crawlers each, the period of reproduction lasting 4–5 weeks. Crawlers of the first generation usually became fixed in about an hour ; males matured in about 26 days and females in 30–32 days, and pairing and reproduction occurred a few days later. Some second-instar individuals of the second and third generations went into diapause in the summer [*cf.* **26** 305], and there was some evidence that females ceased reproduction in hot weather, though fertilised.

The chief food-plants in Italy were apple, pear, peach, plum and quince ; many other plants were occasionally attacked, but not olive, grape-vine or *Citrus*. Young plants were particularly susceptible, but there was considerable variation in resistance between varieties in the plants most severely attacked, and unaccountable differences in susceptibility were observed among plants of the same age and variety. Infestation is spread chiefly by the transport of nursery stock, since the only natural factor capable of effecting it appears to be high wind. There is little risk of infestation from transported fruits or their discarded skins [*cf.* **26** 306], since these do not normally come into contact with trees in the field. In special tests, the Coccid only passed from infested fruits or peel to uninfested fruits if these were in direct contact ; crawlers would not traverse a narrow expanse of earth or sand or surmount

trifling obstacles. In support of this view, it is recalled that *Q. perniciosus* was unknown in Europe until the importation of trees from America was begun, although fruit had been imported for several decades.

The natural enemies of the Coccid are reviewed ; it was parasitised in Italy by *Aphelinus* sp. which destroyed 10–12 per cent. at Versilia, *Prospaltella* sp., another Aphelinid thought to belong to the genus *Aspidiotiphagus*, a Mymarid and a Proctotrupoid. Nitidulids of the genus *Cybocephalus* and Coccinellids were active predators, but the total effect of natural enemies was slight. The usual methods of control by sprays are also reviewed, and an account is given of the technique of fumigating nursery stock with hydrocyanic acid gas [*cf.* **36** 30].

Komárek (J.). **The physiological Damage upon the Ash-tree made by the Scale Insect** *Lecanium coryli* **L.** [*In Czech.*]—*Acta Soc. zool. Čsl.* **10** pp. 156–165, 2 pls., 6 refs. Prague, 1946. (With a Summary in English.)

Ash is the preferred food-plant of *Eulecanium* (*Lecanium*) *coryli*, L., in Czechoslovakia, but only trees in forests on low-lying flooded sites are infested. Severe outbreaks occur at intervals of 10–20 years, and other forests and orchard trees are then attacked, especially acacia [*Robinia*] and plum [*cf. R.A.E.*, A **22** 244] ; the twigs and branches dry up and the opening of the leaf buds is retarded. High mortality occurred among ash trees in southern Moravia in 1942–45, when practically all the mature trees dried up, and since this was accompanied by unusually severe frosts, a change in the level of the subsoil waters and an outbreak of *E. coryli*, a study was made of the effect of the feeding of the scale on the ash twigs to determine its share in causing the death of the trees.

Transverse sections were made through the feeding insects and the corresponding parts of the twig, and the position of the stylets in the tissues and the pathological changes caused were observed. It was found that the injury is done only by the adult females, which feed intensively for a short period after the final moult, increasing 10–15 times in size. This feeding takes place at the times when the leaf buds open and new shoots appear. As only twigs up to 1 cm. in diameter are attacked, the stylets penetrate the cambium rapidly and vertically down to the xylem. The action of the saliva first becomes apparent round the tips of the stylets ; later, the cells along its passage turn brown. The saliva apparently contains cellulase, which destroys the walls of the cells ; it then penetrates into the adjoining cells and destroys the nutritive tissues of the twigs. Cork-tissue is formed through the cambium and persists even after the insect has died. As the diameter of the affected area is smaller than that of the body of the scale, much of the surface may remain healthy even if the scales occur close together. The total result, however, is to arrest the functions of the cambium, since the vascular bundles become cut all the way round at different points. This causes dieback of twigs and branches, the production of side shoots and eventually the death of the whole crown. Young trees or trees in dense or heavily shaded stands, with poorly developed crowns, suffer most. Older trees with a well developed crown dry up only if the infestation coincides with unfavourable changes in the level of the subsoil water or with severe frosts, but in such cases, infestation is the primary cause of death. Such trees died in 1939–42 only when very severely infested.

Börner (C.). **Neue Blattläuse aus Mitteleuropa.** [New Aphids from Central Europe.] 4 pp. Naumburg, the Author, 1940.

Very abbreviated descriptions are given of eight new genera, 64 new species and one new variety. The food-plants of the new species are recorded, but not the localities in which they were taken, apart from the indication in the

title. They include *Anuraphis* (*Yezabura*) *chaerophylli*, which makes galls on the leaves of apple and also occurs on the leaves and rootstocks of *Chaerophyllum*.

Hille Ris Lambers (D.). **De bloedvlekkenluis van appel,** *Sappaphis devecta* **(Wlk.).** [The Red-leaf Apple Aphis.]—*Tijdschr. PlZiekt.* **51** no. 3 pp. 57–72, 2 pls. (1 col.), 6 figs., 13 refs. Wageningen, 1945. (With a Summary in English.)

The author discusses the nomenclature of *Anuraphis* (*Sappaphis*) *devecta*, Wlk., of which he considers that *A.* (*Yezabura*) *chaerophylli*, Börn. [see preceding abstract] and *A.* (*Dentatus*) *communis*, Mordv., are synonyms, and gives notes on its bionomics and annual cycle, based on the literature and on observations in Holland. It causes the leaves of apple to curl and turn red, forming so-called galls, and is the apple Aphid referred to by English and French workers as *A. crataegi*, Kalt. The latter was originally described from apple and *Crataegus*, but the author accepts the view that the true *A. crataegi* migrates from *Crataegus* to carrot, celery and other umbelliferous plants, does not infest apples, and is morphologically distinguishable from the apple Aphid. Börner [*loc. cit.*] implies that the latter migrates from apple to Umbelliferae, but in England, Theobald found oviparae on apple in June and both he and Massee found that infestation occurred on the same trees from year to year, both of which observations render migration unlikely.

A. devecta occurs on apple in a few places in Holland, but is not numerous in any of them. Galls examined on 29th June 1944 were found to contain apterae of the second generation, apterous and alate gynoparae and apterous androparae of the third, and oviparae and alate males of the fourth. The galls are produced by the first two generations, and affected leaves fall in early July. The males and oviparae paired only within the galls, although a few individuals of each were found on the undersides of ungalled leaves. On 11th July, numerous oviparae and a few viviparae occurred on the trunks and lower branches, and winter eggs were found beneath the bark. All the forms observed are described in detail in English and the probable annual cycle is discussed. It is considered that the whole cycle occurs on apple, and that migration to a summer food-plant is most unlikely, since it would involve a return migration in autumn and a second period of oviposition.

The limited distribution of the species on apple is attributed to lack of spread by winged forms ; the few winged gynoparae may migrate to other trees and produce oviparae on them, but it is unlikely that the latter would be fertilised by males flying to these trees, because pairing occurs in the galls. Infestation of adjacent trees may be due to the normal migration of apterous forms. In an orchard in which other Aphids were rare, *A. devecta* was abundant on a few groups of trees ; this was probably due to the failure of insecticidal sprays to reach either the eggs, which are protected by the bark, or the Aphids in the galls. Some control is afforded by natural enemies, of which three Syrphids, two Coccinellids, two Anthocorids, a species of *Chrysopa* and one of *Hemerobius* were observed in the galls. Larvae of the Coccinellid, *Exochomus quadripustulatus*, L., were actively predacious on oviparae on the trunks, and a few Aphids in the galls were found to be parasitised by Chalcidoids.

Marilli (O.). **La disinfestione dei semi di cotone per mezzo del calore.** [The Disinfestation of Cottonseed by Means of Heat.]—*Agricoltura colon.* **37** no. 1 pp. 12–23, 1 graph, 11 refs. Florence, 1943.

Chiaromonte (A.). **Su " La disinfestazione dei semi di cotone per mezzo del calore ".**—*T.c.* no. 2 p. 49. Florence, 1943.

In the first of these papers, the author reviews various methods of heat treatment of cottonseed to destroy long-cycle larvae of *Platyedra gossypiella*,

Saund. In the second, it is pointed out that such treatment is not necessary in the case of seed produced in Somalia, as long-cycle larvae of *Platyedra* do not occur there [*cf. R.A.E.*, A **20** 393].

CHIAROMONTE (A.). **Risultati di tre anni di esperimenti per la introduzione del baco della seta tussah** (*Antheraea pernyi*, **Guérin Méneville**) **in Toscana. (Nota preliminare.)** [The Results of three Years' Experiments for the Introduction of the Tussore Silk Worm (*A. pernyi*) into Tuscany. Preliminary Note.]—*Agricoltura colon.* **37** no. 7 pp. 184–186. Florence, 1943.

Tests were carried out in Tuscany in 1923–25 to ascertain whether *Antheraea pernyi*, Guér., which produces tussore silk, could be established in Italy. The larvae were successfully reared on young oaks (*Quercus cerris*), but were nearly all destroyed by birds in the open, and it was decided that industrial rearing was not practicable.

ALIBERT (H.). **Note sur quelques insectes déprédateurs des plantes cultivées ou spontanées en Côte d'Ivoire.**—*Agron. trop.* **1** no. 7–8 pp. 388–399, 8 figs., 6 refs. Nogent-sur-Marne, 1946.

Descriptions are given of various stages of a number of insects that attack cultivated and wild plants in the Ivory Coast, with brief accounts of their bionomics and the damage they cause and suggestions for the control of some of them by hand-collection or sprays. The egg masses of the Nymphalid, *Acraea alciope*, Hew., are deposited on the underside of the leaves of *Boehmeria nivea*. The larvae hatch in six days and feed in groups, first on the lower epidermis and later on the whole leaf except the veins, sometimes defoliating whole plants in a few days. They pupate hanging from leaves or twigs after 20–25 days, and the adults emerge 10–13 days later. The eggs of *Papilio dardanus* f. *hippocoon*, F., are deposited on the leaves of orange and hatch in 4–5 days. The larvae feed on the parenchyma of the leaves and pupate after 18–20 days; the pupal stage lasts 12 days for the males and 13–14 days for the females. This species is less common and injurious than *P. demodocus*, Esp., and many larvae and pupae are killed by disease. The Thyridid, *Rhodoneura myrsusalis*, Wlk., oviposits on the opening leaves of *Achras zapota*, and the larvae, which hatch in five days, web these together and feed on the parenchyma, but cause little damage. After 15–18 days, they pupate in the soil. The adults emerge after 9–10 days and feed on the sweet exudate from the young buds. The larvae of the Zygaenid, *Pompostola hypparchus*, Cram., live in large numbers on *Ceiba pentandra* (*Eriodendron anfractuosum*), sometimes defoliating big trees in a few days. Pupation takes place in the ground. The adults spend the daytime on low-growing plants and oviposit on the leaves of *C. pentandra*. The larval and pupal stages usually last 15–20 and 8–10 days. Many full-grown larvae are parasitised by the Tachinid, *Sturmia inconspicua*, Mg., which emerged from 78 of 80 larvae collected in the field. The eggs of the Tortricid, *Argyroploce leucotreta*, Meyr., are laid singly on the fruits of guava and *Eugenia uniflora* (*micheli*) and on cotton bolls, and the larvae, which hatch in 10–12 days, feed in the interior of these but return to the surface to pupate. The moths fly at night and live for only 6–10 days. The larvae do serious damage by destroying the seeds and soiling the fibres of cotton and causing the rapid decay of infested fruits.

Adults of the Halticid, *Poëphilina* (*Poëphila*) *flaveola*, Bryant [*cf. R.A.E.*, A **32** 418] feed on the leaves, particularly the young ones, of *Oncoba echinata*, causing little damage, though they periodically destroy a large proportion of

the foliage ; the eggs and larvae develop in the ground. Another Halticid, *Cercyonia citri*, Bryant, perforates the leaves of young orange trees in nurseries, but is never numerous or very injurious. The Galerucid, *Copa occidentalis*, Weise, causes serious damage to cucurbits in kitchen-gardens, completely destroying the leaves and flowers and rendering their cultivation impossible in some areas. The eggs are deposited in masses of 20–30 on or just below the surface of the ground and hatch in 6–8 days. The larvae feed on the leaves and sometimes on the flower petals and pupate on the plant. The adults also feed on the leaves.

The Psyllid, *Phytolyma lata*, Wlk., oviposits on the young shoots of *Chlorophora excelsa*, generally on plants 2–3 years old, and the nymphs develop in the tissues, forming galls on the leaves [*cf.* **33** 329]. Heavy infestation affects the growth of the plants and sometimes kills them.

CALDWELL (N. E. H.) & BRIMBLECOMBE (A. R.). **Distribution of Beetles of the Genus *Tribolium* (Coleoptera : Tenebrionidae) in stored Foodstuffs in Queensland.**—*Qd J. agric. Sci.* **3** no. 2 pp. 92–95, 1 ref. Brisbane, 1946.

Tribolium castaneum, Hbst., and *T. confusum*, Duv., were commonly observed in Queensland during investigations of pests of stored foodstuffs in 1942–43, but their distribution in these products differed to some extent from that in the southern States of Australia, where *T. castaneum* is the more important species in wheat grain and *T. confusum* the dominant one in flour and the only one in flour-mill machinery [*R.A.E.*, A **33** 129]. The Queensland flour-mills are all in the southern part of the State, and investigations in nine of them showed that *T. castaneum* outnumbered *T. confusum* in stored wheat and wheat cleaning machinery, while *T. confusum* predominated in the milling machinery, *T. castaneum* being rare in such situations. The two species were present in approximately equal numbers in spilled flour and sweepings from the flour storage section of the mills, and both appeared to be quite common in warehouses and depôts containing cereals and cereal products. In northern (tropical) Queensland, however, *T. castaneum* was considerably more numerous than *T. confusum*, not only in the whole grains of cereals, cracked and crushed grains, and nuts and nut meats, but also in milled cereal products, especially finely ground ones such as flour, bran and pollard. *T. confusum* was relatively rare, although fairly large populations occasionally occurred in flour, and wheat, cracked maize, pollard and oatmeal were sometimes infested. Of 38 samples of white flour milled in Queensland and stored in the north, 36 were infested by *T. castaneum* and ten by *T. confusum*, whereas the corresponding figures for 13 samples from New South Wales were five and eight. The approximate numbers of adults of the two species were 1,803 and 65, respectively, in the flour milled in Queensland and 59 and 304 in that milled in New South Wales.

The infrequency of *T. castaneum* in flour-mill machinery in Queensland indicates either that it will not thrive in this environment or that the grain stream is not an important source of infestation. Moreover, as *T. confusum* is relatively scarce in flour stored in the north and was not found in 230 samples of flour taken from the packers in a heavily-infested mill and incubated in the laboratory, it is concluded that contaminated machinery is not the normal source of *Tribolium* infestation in bagged flour. The establishment of *T. confusum* in the north is evidently not prevented by climatic factors, since it thrives where it does occur and strong colonies have been maintained for many months in the laboratory. Since *T. castaneum* is the predominant species in grain in the south and in Queensland milled flour in the north, it appeared that grain might be the source of infestation of the flour. Wheat is transported

from the farms to the mills in new jute sacks and these, after passing through mechanical cleaners, are filled with flour. Examination of newly-cleaned sacks showed that some insects, especially those in the seams, were not removed by the cleaners. Samples of flour were taken immediately after the sacks were filled and again before unloading after a rail journey of several days ; only one individual of *T. castaneum* was found in 230 samples at the first examination, but at the second, 130 of *T. castaneum* were obtained from 20 samples, and six of *T. confusum* from three. Infestation was unlikely to have arisen in transit, since railway waggons examined over a lengthy period were found free from *Tribolium*.

Cannon (R. C.) & Caldwell (N. E. H.). **Investigations in the Control of the Tobacco Leaf-miner, *Gnorimoschema operculella* Zell. (Lepidoptera : Gelechiidae), with D.D.T. and " Gammexane ".**—*Qd J. agric. Sci.* **3** no. 2 pp. 96–102, 1 ref. Brisbane, 1946.

Details are given of experiments in northern Queensland in 1945–46 on the control of *Gnorimoschema operculella*, Zell., on tobacco by means of DDT [*R.A.E.*, A **35** 242] and benzene hexachloride containing 13 per cent. γ isomer. The materials used were impregnated dusts containing DDT or benzene hexachloride in a pyrophyllite diluent and sprays prepared from mayonnaise emulsions containing them or from a solution of DDT in solvent naphtha emulsified with Wetsit (sodium alkyl naphthalene sulphonate with pine oil). The dusts were diluted to contain 1 and 2 per cent. p,p′ DDT and 0·26 and 0·52 per cent. γ isomer, and the sprays 0·1 and 0·2 per cent. p,p′ DDT and 0·026 and 0·052 per cent. γ isomer. Three or five applications were made at approximately fortnightly intervals beginning immediately after the seedlings were transplanted. Five applications of either dusts or sprays of DDT gave very effective control ; the sprays from the different concentrates did not differ in efficiency, but were superior to the dusts, probably owing to their more pronounced residual effect. The higher concentration afforded more protection than the lower one, but the differences were not significant. Three applications also gave a high degree of protection, but infestation was beginning to increase four weeks after the last of them. DDT did not damage the plants, but benzene hexachloride was so injurious, especially at the higher concentrations, that its use was discontinued before the end of the tests ; the damage comprised marked stunting of the plants, inhibition of terminal growth, prolific sucker development, and malformation and reduction in the size of the leaves, the surface of which became roughened and mottled. All treatments with benzene hexachloride were less effective than any treatment with DDT, and on examination a fortnight after the fourth application, plants treated with it were found to be attacked by *Heliothis armigera*, Hb., *Plusia chalcites*, Esp., *Prodenia litura*, F., and Tettigoniids, in addition to *G. operculella*. On the basis of these tests, 3–4 applications of the weaker DDT spray or dust are recommended ; the first can most conveniently be made in the seed-bed prior to planting out and should be followed by two or three others at intervals of two weeks or a little more. DDT can also be used to control infestation in the seed-bed.

Short (J. R. T.). **Description and Life History of a new Western Australian Coccid.**—*Proc. Linn. Soc. N.S.W.* **71** pt. 5–6 pp. 257–269, 19 figs., 1 map, 22 refs. Sydney, 1947.

Descriptions are given of all stages of *Apiomorpha egeria*, sp. n., a Coccid that forms galls on *Eucalyptus gomphocephala* and was found in September 1945 to be seriously hindering the establishment of plantations of this tree on

Rottnest Island, Western Australia. The galls in which the males and females develop differ in appearance and are described ; male galls usually occur on the leaves and female ones on the branchlets. Observations showed that the females are viviparous ; the young leave the parent gall over a period of several days between October and late December, and travel rapidly to young growing plant tissue. The males become attached to the leaves and the females to the branchlets, and the galls develop as a result of their feeding. The duration of the instars appeared to vary and to depend on the rate of growth of the galls. The first instar generally occupied ten weeks or more for both sexes ; the females then passed through a second instar, lasting about eight weeks, before becoming adults, and the males a second instar and a prepupal and pupal stage, which together lasted about the same time. The males began to emerge about 9th February, but were not observed in numbers until later in the month. They flew or crawled to the female galls, through the orifice of which pairing occurred. Males kept in glass tubes rarely lived for more than a day. The females survive from February until the larvae emerge in October–December.

A survey in Western Australia indicated that *A. egeria* is confined to *E. gomphocephala* and is scarce on the mainland, where both sexes were very heavily parasitised, the chief parasite of the females being an Encyrtid. The populations on Rottnest Island were very dense, and though both sexes were extensively parasitised, the Encyrtid parasite was not observed there.

MILLER (L. W.). **The Biological Control of Insect Pests in Tasmania.**—*Tasm. J. Agric.* **18** no. 3 pp. 117–119, 3 refs. Hobart, 1947.

Notes are given on the status and effectiveness of seven beneficial insects and a mite that have been introduced into Tasmania during the past 25 years for the control of insect pests of plants. *Aphelinus mali*, Hald. [*cf. R.A.E.*, A **20** 603] is well established in all the apple-growing areas and in many places parasitises a high enough proportion of *Eriosoma lanigerum*, Hsm., to render spraying unnecessary. In the cooler southern districts, however, it does not become numerous until midsummer, and Aphid populations that develop earlier in the year frequently damage the young wood. *Anagrus armatus* var. *nigriventris*, Gir., was liberated in many orchards against *Typhlocyba froggatti*, Baker [**29** 291, etc.], and where it has become well established, it parasitises up to 90 per cent. of the eggs. *T. froggatti* has not been a serious pest in these areas in recent years. *Habrolepis dalmanni*, Westw., is well established and has afforded some control of *Asterolecanium variolosum*, Ratz., on oak [**28** 441] ; the oak Aphid, *Myzocallis annulata*, Htg., is heavily parasitised in many areas by *Aphelinus flavus*, Wlk., and *Trioxys cirsii*, Curt. (*aceris*, Hal.), both of which were accidentally introduced into Tasmania and have since been distributed throughout the State. *T. aceris* is itself parasitised by *Asaphes vulgaris*, Wlk. [*cf.* **28** 441]. *Pteromalus puparum*, L., was introduced from New Zealand in 1942 for liberation against *Pieris rapae*, L., which had by then spread to crucifers throughout Tasmania [*cf.* **30** 272]. Liberations were begun in 1943, and by March 1945, the parasite was abundant in every agricultural district. Populations of *Pieris* were small and unimportant in 1944–46, but it caused considerable damage in 1946–47, possibly because cool, wet weather during the spring and early summer of 1946 retarded the breeding of the parasite more than that of its host. *Encarsia formosa*, Gah. [*cf.* **25** 677] has given effective control of the tomato white-fly, *Trialeurodes vaporariorum*, Westw., in glasshouses on several occasions. *Biscirus lapidarius*, Kramer, a Bdellid mite that was liberated in several areas infested by *Smynthurus viridis*, L. [*cf.* **22** 313 ; **25** 601], is still present in some of them, but does not appear to afford much control.

Fennah (R. G.). **The Insect Pests of Food-crops in the Lesser Antilles.**—[2+] ii+207 pp., 1 pl., 139 figs., 12 refs. St. George's, Grenada, etc., Deps. Agric. Windw. & Leew. Is., 1947.

This handbook is concerned almost entirely with insects, but a few mites and other invertebrates are included. The first four chapters deal with pests of staple root crops, cereals, leguminous crops and miscellaneous vegetables, and the fifth contains formulae and instructions for preparing the sprays, dusts and baits recommended for control. The information on the individual pests in general includes the scientific and native names of each and notes on its status, appearance, bionomics, distribution in the West Indies and alternative food-plants, the nature of the damage caused by it, the parasites known to attack it in the West Indies, and the methods of control most suitable for use under the conditions of the Lesser Antilles. Species that are of importance in the Greater Antilles or in continental America and might become serious pests if introduced into the Lesser Antilles are also included.

Cut Flower Quarantine (Quarantine No. 74).—*U.S. Dep. Agric. B.E.P.Q.*, Q. 74, 3 pp. Washington, D.C., 1947.

This quarantine (effective 1st August 1947) is designed to prevent the introduction into the continental United States, Hawaii and Porto Rico of injurious insects and plant diseases with cut flowers imported from foreign countries. It requires the inspection and, if necessary, treatment at the port of entry of cut flowers produced in countries or localities other than Canada, Labrador, Newfoundland and the United States, and provides for the prohibition, except under permit, of the entry of cut flowers that may be designated as involving a special risk. It does not affect provisions applicable to cut flowers included in special quarantines or other restrictive orders.

MacDonald (H. A.). **Birdsfoot Trefoil (*Lotus corniculatus* L.) its Characteristics and Potentialities as a Forage Legume.**—*Mem. Cornell agric. Exp. Sta.* no. 261, 182 pp., 50 figs., 21½ pp. refs. [Ithaca, N.Y.] 1946.

This paper includes a short section (p. 156) on the insects that attack *Lotus corniculatus* in New York. Minor injury by leafhoppers (*Empoasca fabae*, Harr.) was observed, typical symptoms being leaf yellowing, tipburn and bronzing, sometimes of the entire leaf and petals [*cf. R.A.E.*, A **17** 562], and in 1939 *Bruchophagus gibbus*, Boh. (*funebris*, How.) was found in an isolated area in the east of the State infesting 30–57 per cent. of the seeds ripe on 5th July. Seed samples collected from various areas since that date showed 0–47 per cent. infestation. No infestation was found at Ithaca until 1941, when there was 2 per cent. in harvested seed. Early maturing strains were found to be the most severely affected. Although *B. gibbus* is not considered a serious pest at present, it may become so if seed production of *L. corniculatus* increases in amount and distribution.

Groves (K.), McCulloch (E. C.) & St. John (J. L.). **Relative Toxicity to Swine of Lead Arsenate Spray Residue, Lead Arsenate, Lead Acetate, and Arsenic Trioxide.**—*J. agric. Res.* **73** no. 5 pp. 159–166, 1 fig., 9 refs. Washington, D.C., 1946.

In investigations carried out to determine whether unwashed cull apples that had been sprayed with lead arsenate could safely be fed to pigs and whether

the meat of animals fed on such apples would contain significant amounts of lead and arsenic, and to obtain data on the storage of lead and arsenic in the body following long-continued ingestion of lead-arsenate spray residues, one pig was fed on as much as it would consume of the peelings, including the stem and calyx ends, of heavily sprayed apples, three others on a diet including equivalent amounts of lead arsenate, arsenic as arsenic trioxide and lead as lead acetate, one on a quarter of the quantity of peelings of sprayed apples received by the first and one on food containing neither lead nor arsenic. The experimental feeding was carried out from April 1941, when the pigs were three months old, until August 1941 and again, with short interruptions, from November 1941 to April 1942, when they were killed.

The results obtained indicate that lead-arsenate spray residues are much less toxic to pigs than has generally been supposed. The first pig consumed the spray residue from 2,220 lb. heavily sprayed apples, containing 114·8 gm. lead arsenate, an amount much in excess of what would be consumed by pigs receiving cull apples according to commercial practice, but gained in weight approximately as well as the control pig. The pigs that received lead arsenate, arsenic trioxide and the smaller quantity of spray residue also remained healthy and gained about the same weight. Blood studies made at various times during the feeding tests revealed no consistent or significant deviation from normal, and autopsies showed that of the edible portions, only the livers of the first two pigs, which received large quantities of lead arsenate, contained more lead than 7·14 parts per million (the limit for spray residue on apples and pears in the United States), and none of the organs analysed contained more than the limit of 3·57 p.p.m. of arsenic trioxide. The pig that was given lead acetate died after the first feeding period, and no autopsy was performed.

Papers noticed by Title only.

Martelli (G. M.). **Notizie su due ditteri viventi in Tripolitania sul peperone e rapporti intercorrenti tra essi.** [Notes on two Diptera living on *Capsicum annuum* in Tripolitania, *Ceratitis capitata*, Wied., and *Lonchaea aurea*, Macq. (*splendida*, Lw.), and the Relationship between them.]—*Agricoltura colon.* **37** no. 2 pp. 31–43, 56 refs. Florence, 1943. [For shorter account see *R.A.E.*, A **32** 84.]

Kleine (R.). **Die Gesamtliteratur der Borkenkäfer (Ipidae und Platypodidae) bis einschliesslich 1938.** [A Bibliography of the Bark-beetles (Scolytidae and Platypodidae) up to and including 1938.]—*Stettin. ent. Ztg* **100** pt. 1–2 pp. 1–184. Stettin, 1939.

Morstatt (H.). **Bibliographie der Pflanzenschutzliteratur. Die Jahre 1937–1939.** [A Bibliography of Plant Protection Literature in 1937–39.]—iv+430 pp.; iv+401 pp.; iv+378 pp. Berlin, P. Parey, 1939, 1942, 1944. [*Cf. R.A.E.*, A **26** 248.]

Schmidt (G.). **Gebräuchliche Namen von Schadinsekten in verschiedenen Ländern. (Fortsetzung und Schluss.)** [Popular Names of Insect Pests in various Countries. Continuation and Conclusion.]—*Ent. Beih. Berl.* **7** pp. [1+] 161–364, 4 pp. refs. Berlin, 1940. [*Cf. R.A.E.*, A **27** 437.]

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